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EXPERIMENTAL STUDIES ON THE CURATIVE TREATMENT OF SURRA IN NATIVE HORSES IN THE PHILIPPINES, II

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The experiments discussed below are a continuation of the investigation on the chemotherapy of surra in Philippine horses, previously published by the writer (1934). Some of the results recorded in that paper demonstrated that naganol given intravenously alone is capable of sterilizing the animal body of surra trypanosomes, provided there is no cerebrospinal involvement. Conversely, it was also shown that when the causative agent has already gained a foothold in the cerebrospinal fluid, the drug fails to effect a cure, due apparently to its lack of power to penetrate the meninges in a concentration deadly to the trypanosome. Rodenwalt and Douwes (1922) and Bubberman, Douwes, and van Bergen (1925) found in their investigations of equine surra in the Dutch East Indies that naganol administered intravenously is likely to effect a cure only in the incipient stage of infection; that is, when clinical symptoms are absent or have just made their appearance, indicating the possibility that the organism has not yet found its way into the nervous system. In recognition of these facts and in view of the present trend of opinion with regard to surra infection, namely, that relapses during the treatment originate mainly from nervous complications, the advantages of the injection of naganol simultaneously into the cerebrospinal canal and into the circulation are not

difficult to appreciate. Moreover, because of the satisfactory results obtained by Edwards (1926) in India from the intrathecal-intravenous treatment of equine surra with naganol alone and later confirmed by Williams (1926), it seems desirable to exploit the possibilities of the treatment in surra as it occurs in the Philippine Archipelago, in spite of the technical difficulties attending its application.

Some of the animals treated by the intrathecal-intravenous method were subsequently subjected to etharsanol-naganol treatment, for reasons that will be noted below.

MATERIALS AND METHODS

The same materials as in the previous experiments were employed in the investigation, but all of the horses were infected experimentally.

PROCEDURE

With the exception of two animals which were infected intrathecally, the horses were infected subcutaneously and treated when the cerebrospinal fluid was positively known to be involved by animal inoculation. The technic employed by Edwards was closely observed. It consisted briefly in casting the animal after the mane in the occipito-atlantal articulation had been clipped close and disinfected with tincture of iodine. With the horse properly secured in a recumbent position, a sterile gauge 16 needle 7½ centimeters long was introduced slowly through the skin and the tissues beneath and directed obliquely following the wing of the atlas. With careful manipulation one would feel and hear a sound similar to the one produced by puncturing a piece of tissue paper with a sharp needle, indicating that the meninges were already perforated. Immediately after, the cerebrospinal fluid dribbled out. With the needle kept in situ, a piece of india-rubber tubing 12 centimeters long and with a bore of 0.3 centimeter was slipped over the butt. After about 15 cubic centimeters of the fluid had oozed out, the free end was engaged to the nozzle of an injection syringe previously filled with naganol solution, the latter being injected subsequently and slowly into the cerebrospinal canal. The syringe was disengaged from the rubber tubing while the latter was firmly pressed with the balls of the index finger and the thumb. The tube was then squeezed towards the needle to drive whatever solution had remained in it into the canal. When this had been accomplished,

the needle was withdrawn and the horse released. Immediately after, the intravenous injection was given.

The dose of naganol for intrathecal injection was 0.045 milligram in 0.1 per cent solution, and for the intravenous injection 15 milligrams in 10 per cent solution per kilogram live body weight, respectively. In general the injections were administered fortnightly until three courses were injected.

As in work previously reported, the simultaneous injections of etharsanol and naganol were employed in the three relapsed animals, observing the same doses and manner of administration.

The complement-fixation test [1] for surra was employed in some of the experimental horses in conjunction with the microscopic examination of the peripheral blood and animal inoculation.

EXPERIMENTS AND RESULTS

To determine the efficiency of the simultaneous intrathecal and intravenous injections of naganol in experimental surra among Philippine horses the following experiments were made.

EXPERIMENT 1. HORSE 67; WEIGHT, 161 KILOGRAMS; A WORN-OUT CASTAWAY CALESA HORSE

January 16, 1934. Inoculated subcutaneously with surra trypanosomes.
January 19. Blood positive (+).
January 20. Blood negative.
January 21. Blood positive (+).
January 22, 23, and 24. Blood positive (++++).
January 25. Blood positive (++++). Animal unable to stand. Given the initial simultaneous treatment of naganol in the doses of 6.7 milligrams in 0.1 per cent concentration for the intrathecal injection and 2.25 grams in 10 per cent solution for the intravenous injection. In the course of the intrathecal injection 6 cubic centimeters of cerebrospinal fluid was obtained and injected immediately into a white rat.
January 26. Animal was found dead; no autopsy made.
February 4. White rat positive (++); died five days later.

EXPERIMENT 2. HORSE 68; WEIGHT, 154 KILOGRAMS

February 7, 1934. Infected subcutaneously with surra blood.
February 13. Blood positive (+).
February 14. Blood positive (++++).
February 15. Blood positive (++).
February 16. Blood positive (+).
February 17 and 18. Blood positive (++).

[1] The author is much indebted to Doctors Topacio and Acevedo, both of the Research Division, Bureau of Animal Industry, for performing the complement-fixation test.

February 19. Blood negative.

February 20. Blood positive (++).

February 21 and 22. Blood positive (++++).

February 23. Blood positive (+++).

February 24 and 25. Blood positive (++).

February 26. Blood positive (+). Animal reweighed (121 kilograms) and subjected to the simultaneous intrathecal and intravenous injections of naganol in the doses of 5.445 milligrams in 0.1 per cent solution for the former and 1.82 grams in 10 per cent solution for the latter. Simultaneously two white rats were inoculated intraperitoneally with 7 cubic centimeters each of the cerebrospinal fluid obtained in the process of intrathecal injection. These laboratory animals became positive later and died.

February 27. Blood negative. Horse depressed, appetite poor and œdema of the muzzle noted. The temperature rose to 40° C.

March 1. Animal improved in condition and its appetite and body temperature returned to normal. A perirectal eruption developed which, however, healed in the course of ten days.

March 16. Blood positive (+). Temperature 39.9° C. Treatment repeated.

March 17. Blood negative. Horse depressed again, temperature rising to 40° C. Two white rats were inoculated with cerebrospinal fluid obtained in the process of treatment; these became positive and died in the course of five days.

March 31. A third treatment given. Two white rats were again secured and infected with the cerebrospinal fluid. These laboratory animals succumbed later to the infective inoculation.

April 14. A fourth course of the intrathecal-intravenous injection given. Two other white rats were simultaneously injected with cerebrospinal fluid. Both laboratory animals caught the infective inoculation and died.

June 9 and 16. Complement-fixation tests positive (++++). Blood negative.

June 23. Cerebrospinal fluid tested for surra trypanosomes by inoculating two white rats. Both escaped infection. Susceptibility test made; rats caught surra and died. Complement-fixation test positive (++++).

June 30 and July 2 and 13. Complement-fixation tests repeated; all positive (++++).

August 19. One hundred twenty-seven days after last injection, blood positive (+).

August 28. Animal died very much emaciated.

EXPERIMENT 3. HORSE 69; WEIGHT, 166 KILOGRAMS

April 9, 1934. Infected subcutaneously with surra organisms.

April 18 and 19. Blood positive (+).

April 20. Blood positive (++++).

April 21. Blood negative.

April 22 and 23. Blood positive (+).

April 24. Blood positive (++).

April 25, 26, 27, 28, and 29. Blood positive (++++).

April 30. Blood negative.

May 1. Blood negative. Horse weighed (149 kilograms) and subjected to intrathecal-intravenous treatment of naganol, getting the same doses as

in the foregoing experiments. Two white rats were given cerebrospinal fluid obtained incidentally to intrathecal injection. Complement-fixation test negative.

May 2. Horse depressed and took food sparingly; with a high temperature. However, this train of symptoms disappeared in the course of time. A perirectal eruption was observed and behaved in much the same manner as in experiment 2. Blood negative.

May 7. Blood of both white rats positive (++).

May 9. One of the white rats died.

May 10. Complement-fixation test negative; other white rat died.

May 15. Treatment repeated.

May 16. Reaction to the treatment less intense.

May 17. Complement-fixation test positive (+).

May 25. Blood positive (+).

May 30. Treated. One white rat given 10 cubic centimeters cerebrospinal fluid obtained in the process of the treatment. Complement-fixation test positive (+++).

June 6. White rat positive (++).

June 7. Complement-fixation test positive (++++).

June 16. White rat died.

June 17. Blood positive (+).

June 18. Blood positive (++). In view of the unfavorable result, the treatment was discontinued.

EXPERIMENT 4. HORSE 70; WEIGHT, 109 KILOGRAMS

April 9, 1934. Inoculated with surra organisms.

April 21. Blood negative. Reinoculated.

April 27. Blood positive (+).

April 28 and 29. Blood positive (++++).

April 30. Blood positive (+++).

May 1. Blood positive (++++). Complement-fixation test positive (+).

May 2. Blood positive (++).

May 3 and 4. Blood negative.

May 5. Blood positive (+).

May 6 and 7. Blood negative.

May 8. Blood not examined.

May 9. Blood positive (++++).

May 10. Blood positive (+). Complement-fixation test negative.

May 11. Blood not examined.

May 12. Blood positive (+). Horse reweighed and tipped the scale at 86 kilograms, a decrease of 23 kilograms. The animal was given simultaneous intrathecal and intravenous injections of naganol in doses of 3.87 milligrams and 1.29 grams, respectively, and in the same concentrations as in the above experiment. At the same time two white rats were given cerebrospinal fluid; each received 8 cubic centimeters, developed surra, and died.

May 13. Blood negative. Animal depressed, with impaired appetite. Temperature 40.2° C.

May 15. Horse found dead. Since the body was still warm to the touch, cerebrospinal fluid was obtained and injected into two other white rats.

Both white rats caught the infective inoculation and died. Close inspection of the animal revealed contusions and bruises on the head indicating that the horse must have developed brain disease.

EXPERIMENT 5. HORSE 71; WEIGHT, 151 KILOGRAMS

September 1, 1934. Inoculated subcutaneously with surra organisms.

September 3 and 6. Complement-fixation tests negative.

September 7. Blood positive (+).

September 8 and 9. Blood positive (++++).

September 10. Blood positive (++++). Complement-fixation test negative.

September 11. Blood positive (+++).

September 12 and 13. Blood positive (+).

September 14. Blood positive (++++).

September 15. Blood positive (++++). Complement-fixation test positive; first tube (+), second tube (++).

September 16. Blood negative.

September 17. Blood negative. Horse subjected to intrathecal-intravenous treatment. At the same time two white rats were inoculated with cerebrospinal fluid, developed surra, and died subsequently.

September 18. Animal depressed with eyes half-closed and eyelids œdematous; muzzle swollen and head pendant. Appetite poor; temperature 40° C. The above symptoms soon disappeared; however, perirectal eruption appeared, and subsided in about ten days.

October 1. Treatment repeated.

October 2. Blood positive (+). Instead of being continued as in experiment 3, the treatment was suspended and the horse was used in the second phase of the work.

EXPERIMENT 6. HORSE 72; WEIGHT, 164 KILOGRAMS

December 30, 1934. Infected intrathecally with surra trypanosomes.

January 3 and 4, 1935. Blood positive (+).

January 5. Blood positive (++++).

January 6. Blood and cerebrospinal fluid positive (++++). Animal reweighed and lost 14 kilograms. Afterwards it was subjected to intrathecal-intravenous injection of naganol, 6.75 milligrams for the intrathecal and 2.25 grams for the intravenous injection in the same concentrations as in the foregoing experiments. Complement-fixation test negative.

January 7. Blood negative.

January 18. Complement-fixation test positive (+++).

January 20. Treatment repeated.

February 1. Complement-fixation test positive (++++).

Februay 3. Given last simultaneous intrathecal-intravenous injection.

March 5. Complement-fixation test positive (+).

April 1. Complement-fixation test positive (++++).

April 30. Blood positive (++). Ten cubic centimeters of blood inoculated into a white rat produced the disease in four days; rat died subsequently. The horse being still strong was used in the second phase of the investigation.

EXPERIMENT 7. HORSE 73; WEIGHT, 141 KILOGRAMS

September 14, 1935. Infected intrathecally with surra trypanosomes.

September 19. Blood positive (++++). Animal depressed; appetite poor.

September 20. Blood positive (++++). Complement-fixation test negative. Horse lethargic; appetite poor.

September 21. Blood positive (++++). Animal lethargic; appetite impaired.

September 22. Blood positive (++++). Temperature rose to 40° C. Condition the same as above. The animal was reweighed and tipped the scale at 131 kilograms. Given first treatment.

September 23. Blood negative. Appetite improved although animal is still depressed. Temperature returned to normal.

September 25. Blood negative. A perirectal eruption noted.

October 6. Blood negative. Treatment repeated. Complement-fixation test negative. Perirectal eruption almost healed; œdema of pendant portion appeared.

October 16. Blood negative. Eruption of the rectum disappeared entirely. Appetite fair; œdema present.

October 20. Blood negative as well as cerebrospinal fluid. Given last injection.

October 31. Blood negative; severe laminitis observed; œdema disappeared.

November 8. Blood negative; laminitis slightly improved.

November 13. Blood negative; animal down, unable to stand, struggling desperately to get up. When helped to its feet, the animal manifested forced movements. In the afternoon it was killed in extremis. Two white rats were given cerebrospinal fluid but failed to develop surra. After a month susceptibility test made. Both came down with the disease and died subsequently.

Experiments 8, 9, and 10 were intended to determine the value of etharsanol-naganol treatment in experimental surra in horses that failed to respond to the intrathecal-intravenous injections.

EXPERIMENT 8. HORSE 69; WEIGHT, 149 KILOGRAMS

June 17, 1934. Relapsed as recorded in experiment 3 in spite of the intrathecal-intravenous treatment of naganol.

June 19. Blood negative. Two white rats inoculated with blood. Both developed surra after seven days and died in the course of five days. Given simultaneous intravenous injections of etharsanol and naganol in doses of 2.24 grams and 1.49 grams in 10 per cent concentration, respectively.

June 20. Blood negative. Complement-fixation test positive (++++).

June 25. Blood negative. Treatment repeated. The dose of naganol reduced to 0.745 gram, the etharsanol remaining the same as in the initial injection.

July 1. Blood negative. Given the third treatment, the same doses as immediately above.

July 3. Blood negative. Complement fixation positive (++++) in three tubes.

August 3. Blood negative. Complement fixation positive; ++++ in the first, +++ in the second, and ++ in the third tube.

August 15. Blood negative. Complement fixation positive; ++++ in the first and second tubes and +++ in the third tube. Animal was gaining in weight (159 kilograms).

September 3. Blood negative. Complement fixation negative.

September 30. Blood negative. Complement fixation negative.

October 16 and November 5. Blood negative. Complement fixation negative.

November 21. Blood negative. Cerebrospinal fluid obtained and injected into two white rats. Both failed to develop surra, hence after thirty days' observation they were inoculated with surra organisms. In five days surra organisms appeared in the tail blood; died four days later.

February 1, 1935. Blood negative. Complement fixation suspicious (±).

April 8 and September 4 and 20, 1935, and February 17, 1936. Blood negative (animal inoculation). Complement fixation negative. Animal weighed 160 kilograms.

August 1. Animal in good condition; weight 191 kilograms.

EXPERIMENT 9. HORSE 71; WEIGHT, 118 KILOGRAMS

October 2, 1934. Relapsed as recorded in experiment 5 after the second intrathecal-intravenous injection of naganol.

October 3. Blood positive (+). Complement fixation ++++ in two tubes. Given the initial treatment of etharsanol-naganol combination, the same doses as in experiment 8.

October 4. Blood negative.

October 9. Blood negative; treatment repeated.

October 16. Blood negative; treatment repeated.

October 30. Blood negative. Complement fixation positive (+).

November 16 and December 4, 1934; February 1 and March 5, 1935; and February 17, 1936. Complement fixation negative. Weight of the horse 157 kilograms; condition good. Animal inoculation negative.

EXPERIMENT 10. HORSE 72; WEIGHT, 137 KILOGRAMS

April 30, 1935. Relapsed as recorded in experiment 6 from the intrathecal-intravenous treatment of naganol. Blood obtained from the horse and injected into a white rat; the latter killed inside of ten days after the first appearance of the trypanosomes in the tail blood.

May 3. Given initial treatment.

May 9 and 16. Blood negative. Treatment repeated on both days.

July 25 and September 4. Blood negative. Complement fixation negative.

September 13. Cerebrospinal fluid obtained and injected into two white rats. Both escaped infection. Susceptibility test made. Rats developed surra and died.

February 17, 1936. Blood negative. Complement-fixation test negative. Horse in good condition.

July 30. Animal in good condition and weighed 163 kilograms. Animal inoculation negative.

For the sake of clarity some of the results of the experiments were condensed and are given in Tables 1 and 2.

TABLE 1.—*Showing some of the results obtained in experiments 1 to 7.*

Experiment No.	Animal No.	Infected.	Incubation period.	Weight of animal.			Treatment.		
				Before infection.	Before treatment.	After relapse.	Date.	Intrathecal.	Intravenous.
			Days.	*kg.*	*kg.*	*kg.*		*mg.*	*g.*
1	67	Jan. 16, 1934	4	161			Jan. 25, 1934	6.70	2.25
2	68	Feb. 7, 1934	7	154	121		Feb. 26, 1934	5.445	1.82
							Mar. 16, 1934	5.445	1.82
							Mar. 31, 1934	5.445	1.82
							Apr. 14, 1934	5.445	1.82
3	69	Apr. 9, 1934	10	166	149	149	May 1, 1934	6.71	2.24
							May 15, 1934	6.71	2.24
							May 30, 1934	6.71	2.24
4	70	Apr. 9 and 21, 1934	7	109	86		May 12, 1934	3.87	1.29
5	71	Sept. 1, 1934	7	151	118	118	Sept. 17, 1934	5.31	1.77
							Oct. 1, 1934	5.31	1.77
6	72	Dec. 30, 1934	5	164	150	137	Jan. 6, 1935	6.75	2.25
							Jan. 20, 1935	6.75	2.25
							Feb. 3, 1935	6.75	2.25
7	73	Sept. 14, 1935	6	141	131		Sept. 22, 1935	5.895	1.97
							Oct. 6, 1935	5.895	1.97
							Oct. 20, 1935	5.895	1.97

TABLE 1.—*Showing some of the results obtained in experiments 1 to 7*—Continued.

Experiment No.	Animal No.	Results.	Remarks.
1	67	Died the day following	This was a worn-out castaway calesa horse, hence very susceptible to surra organisms; cerebrospinal fluid positive as a result of animal inoculation.
2	68	Relapsed Mar. 16 and Aug. 19, 1934; died Aug. 28, 1934	Cerebrospinal fluid positive as a result of animal inoculation.
3	69	Relapsed May 25 and June 17, 1934	June 19, 1934, subjected to etharsanol-naganol treatment; cerebrospinal fluid positive (animal inoculation).
4	70	Died May 15, 1934; cerebrospinal fluid positive for surra trypanosomes.	Cerebrospinal fluid positive as a result of animal inoculation.
5	71	Relapsed Oct. 2, 1934.	Oct. 2, 1934, subjected to etharsanol-naganol treatment; cerebrospinal fluid positive (animal inoculation).
6	72	Relapsed Apr. 30, 1935.	Infected intrathecally; subjected to etharsanol-naganol treatment May 3, 1935; cerebrospinal fluid positive (microscopic examination).
7	73	Killed in extremis Nov. 13, 1935; surra organisms were not recovered from the cerebrospinal fluid.	Infected intrathecally; cerebrospinal fluid positive by microscopic examination.

TABLE 2.—*Showing some of the results obtained in experiments 8 to 10.*

Experiment No.	Horse No.	Date relapsed from intrathecal-intravenous injections.	Weight.		Treatment.			Duration between last injection and final observation.		Final observation.
			Before treatment.	Final observation.	Date given.	Etharsanol.	Naganol.			
			kg.	*kg.*		*g.*	*g.*	*Yrs.*	*mons.*	
8	69	June 17, 1934	149	191	June 19, 1934	2.24	1.49	2	1.5	No relapse; compliment-fixation test negative; condition good.
					June 25, 1934	2.24	0.745			
					July 1, 1934	2.24	0.745			
9	71	Oct. 2, 1934	118	157	Oct. 3, 1934	1.77	1.18	1	10	Do.
					Oct. 9, 1934	1.77	0.59			
					Oct. 16, 1934	1.77	0.59			
10	72	Apr. 30, 1935	137	163	May 3, 1935	2.06	1.37	1	3	Do.
					May 9, 1935	2.06	0.685			
					May 16, 1935	2.06	0.685			

DISCUSSION

Treatment of equine surra with intrathecal-intravenous injections of naganol.—All of the seven horses employed failed to respond to the treatment given. While horses 67 and 70 died in the course of the treatment, horse 73 was killed in extremis at the end of the post-treatment observation period covering twenty-four days. Moreover, horse 67 being a worn-out, castaway calesa animal was quite susceptible to surra organisms and evidently too weak to bear the medicament administered, hence considered a poor risk. Horse 71 received two sets of injections; horses 68, 69, and 72, each received a complete course of treatment (in fact horse 68 received four sets of simultaneous intrathecal-intravenous injections), but relapses were noted in all cases. So far as the results of the experiments went, they disagree with the findings of Edwards and Williams in their studies of surra in India, but to some extent support those of Tubangui (1930) wherein tartar emetic was used. Furthermore, interesting evidence was shown by horse 68 in which the parasites in the cerebrospinal canal were absent as determined by animal inoculation, but not to the extent of complete absence, as a relapse was likewise observed at the end of the post-treatment observation period covering one hundred twenty-seven days. A similar condition was presented by horse 73, but although it showed nervous involvement the organisms were never recovered, probably due to the fact that the animal was killed in extremis quite early after treatment. Considering that naganol has been found effective against surra without nervous complication, the above circumstance would be difficult to explain were it not for the findings of Reichenow (1921) in his work on human trypanosomiasis wherein he stated that trypanosomes decreased or even totally disappeared in the cerebrospinal fluid after intrathecal injections, but the parasites always returned—a fact explained by the assumption that medicaments introduced into the cerebrospinal canal do not diffuse evenly with the liquor cerebralis and more especially do not penetrate into the ventricles of the brain, thus some of the trypanosomes may remain unaffected and subsequently bring about a relapse.

Treatment of relapsed horses with etharsanol-naganol combination.—The three animals (horses 69, 71, and 72 in experiments 8, 9, and 10) subjected to simultaneous treatment with etharsanol and naganol all responded satisfactorily. The results here presented furnish further evidence of the efficacy of

the etharsanol-naganol treatment against equine surra. The drawback, however, is the toxicity of the combination in some natural cases of surra treated where deaths have been recorded in the course of the treatment. In declaring the cases here described cured, microscopic examination of the blood, animal inoculation, complement-fixation test, and the period of post-treatment observation ranging from one to two years were observed. Furthermore, the increased weight and the good condition of the animals used at the termination of the investigation were also considered.

The complement-fixation test made in some of the horses used furnished an invaluable aid in declaring the animal free of surra. However, the test failed to detect the occurrence of the disease in the early stages even though the blood was already teeming with the surra parasites, as in horses 70, 71, and 72.

SUMMARY AND CONCLUSIONS

Experiments to determine the value of the simultaneous intrathecal and intravenous injections of naganol and the combination of etharsanol and naganol treatment in relapsed animals were performed.

Of the seven horses employed in the intrathecal-intravenous method, four were able to stand the complete course of the treatment with the exception of one which received only two injections, but all four relapsed. Of the remaining animals two died in the course of the treatment and one was killed in extremis at the end of the post-treatment observation period covering twenty-four days. In view of the above the intrathecal-intravenous injections of naganol as a treatment of experimental surra in Philippine horses was found to be of not much value and to some extent attended with danger.

The three animals subjected to the etharsanol-naganol treatment recovered. In declaring these cases recovered, animal inoculation, complement-fixation test, duration of post-treatment observation, microscopic examination of the blood, increase in weight, and good condition of the animals were considered.

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TANNIN CONTENT OF PHILIPPINE OAK BARKS

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This paper is a continuation of our work on the tannin content of Philippine barks and woods.[1]

In the Philippines the tanning of sole leather is now done mostly with kamachile bark, *Pithecolobium dulce* (Roxb.) Benth. and there is often obtained a poor quality of leather with a disagreeable odor.

Hides tanned properly with oak-bark extract give a leather that is distinguished by a light tan color, firm texture, and durability. The oak tannin combines well with hides and penetrates quickly; consequently it is one of the best materials for producing heavy leather.[2]

According to Wilson,[3] oak barks collected from different countries had a tannin content that varied from 1.5 to 29 per cent.

Formerly the species of oak commonly used for tanning were *Quercus robur* and *Q. prinus,* containing 9 to 12 per cent tannin; *Quercus densiflora,* with a tannin content of 10 to 29 per cent, was also employed when available.

Recently we analyzed several species of oak bark grown in various districts in the Philippines. The official hide-powder method, adopted by the American Leather Chemists Association, was used. The results are recorded in Table 1. As shown by the data six species of Philippine oak bark contained more than 10 per cent tannin. Pieces of hides were tanned very satisfactorily with infusions of these barks. Apparently these barks compare favorably with those in other countries.

Of the Philippine barks analyzed *Quercus pruinosa,* grown at the Cebu Forest Station, gave the highest tannin content (17.76 per cent). When this species was grown near Baguio it gave the lowest tannin content (3.52 per cent).

[1] Baens, L., F. M. Yenko, and A. P. West, Philip. Journ. Sci. 55 (1934) 177.

[2] Rogers, A., Practical Tanning (1922) 265. Bennett, H. G., Animal Proteins (1921) 34.

[3] The Chemistry of Leather Manufacture 1 (1928) 401 and 407.

TABLE 1.—*Analyses of Philippine oak barks.*

Sample No.[a]	Scientific name.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	*Quercus Robinsonii* Merr.	13.96	3.95	77.95	19.58	17.91	1.67
2	——do.	15.65	5.14	75.28	23.97	20.79	3.18
3	*Quercus Mabesae* Merr.	11.47	4.09	73.71	16.32	15.56	0.76
4	*Quercus soleriana* Vid.	12.81	3.51	78.49	18.17	16.32	1.85
5	*Quercus philippinensis* A. DC.	14.90	3.08	82.87	19.61	17.98	1.63
6	*Quercus Bennettii* Miq.	16.01	3.30	82.91	21.69	19.31	2.38
7	*Quercus philippinensis* A. DC.	15.79	3.39	82.33	23.38	19.18	4.20
8	*Quercus ovalis* Blco.	3.77	3.01	55.60	7.10	6.78	0.32
9	*Quercus pruinosa* Bl.	3.52	4.19	45.65	8.05	7.71	0.34
10	*Quercus Woodii* Hance	9.06	11.20	44.72	22.56	20.26	2.30
11	*Quercus Curranii* Merr.	8.78	10.40	45.78	20.15	19.18	0.97
12	*Quercus soleriana* Vid.	4.78	6.18	43.61	11.67	10.96	0.71
13	*Quercus sundaica* Bl.	8.78	11.78	42.70	20.80	20.56	0.24
14	*Quercus apoensis* Elmer.	6.08	4.71	56.35	11.68	10.79	0.89
15	*Quercus pruinosa* Bl.	17.76	8.85	66.74	27.79	26.61	1.18

[a] Samples 1 to 7 were collected at Los Baños, Laguna Province. Samples 8 to 13 were collected at Baguio, Mountain Province. Sample 14 was collected at Babatñgon, Leyte. Sample 15 was collected at the forest station in Cebu.

Oak barks from trees grown at the Los Baños Forest Station gave a tannin content that varied from 11.47 to 16.01 per cent.

In this investigation the oak barks used were kindly presented to us by Mr. Arthur F. Fischer, director of the Bureau of Forestry.

The identification of barks 1 to 7 was made by Mr. Mamerto D. Sulit, of the Bureau of Forestry. All the other barks were identified by Dr. Eduardo Quisumbing, of the Bureau of Science.

SUMMARY

Philippine oak barks of various species were analyzed for their tannin content.

Six species contained more than 10 per cent tannin. The Philippine barks compare favorably in tannin content with oak barks grown in other countries.

The species *Quercus pruinosa*, grown at the Cebu Forest Station, gave the highest tannin content (17.76 per cent). When this species was grown near Baguio it gave the lowest tannin content (3.52 per cent).

EFFECT OF MOLDS ON SOME PHILIPPINE TANNING LIQUORS, II

By Luz Baens and F. M. Yenko
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FOUR TEXT FIGURES

This paper is a continuation of the work reported in our first publication[1]—the effect of molds on Philippine tanning liquors.

Several years ago we investigated the tannin content of a large number of Philippine tanbarks.[2] Some of them were found to contain a rather high percentage of tannin as shown by the data recorded in Table 1, in which there is also included the analysis of betel-nut kernel.

These particular materials (Table 1) were selected for the mold experiments recorded in this paper. Brief descriptions of the trees from which they were obtained are as follows:

Betel nut, *Areca catechu* L.[3] This tall and slender palm is found in and about towns throughout the settled areas of the Philippines. It reaches a height of 10 meters and a diameter of 10 to 15 centimeters. It has dark green pinnate leaves about 3 meters long. The reddish yellow fruits grow on the stem below the leaves. This palm is frequently spontaneous and occurs in second-growth forests, but is rarely found distant from cultivation. It has been reported from a virgin forest in only a single locality in Palawan.

In the Philippines, as in all the Indo-Malayan and Polynesian regions, the fruits of this palm are extensively utilized for chewing with lime and the leaves of the betel pepper. They are also used to some extent in dyeing red and black shades.

Black wattle, *Acacia decurrens* Willd. The bark was obtained from trees grown in Bukidnon Province, Mindanao. In the

[1] Yenko, F. M., Luz Baens, and F. B. Serrano, Philip. Journ. Sci. 60 (1936) 241.

[2] Baens, Luz, F. M. Yenko, A. P. West, and H. M. Curran, Philip. Journ. Sci. 55 (1934) 177.

[3] Brown, William H.. Minor Products of Philippine Forests 1 (1920) 144.

sitio called Kaatoan these trees reached an average height of 5.29 meters in about four years. They were cultivated from seeds that were obtained from the Forest Research Institute, Buitenzorg, Java. In some districts in Bukidnon the black-wattle tree grows very well, and it is quite likely that it could be cultivated successfully on rich soil where the climate is similar to that of Bukidnon.

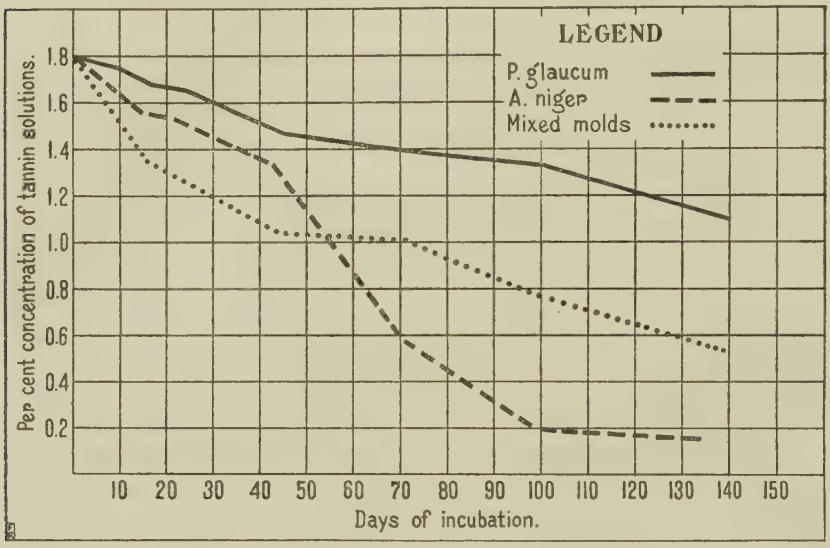

FIG. 1. Effect of molds on betel-nut solutions.

Kalumpit, *Terminalia edulis* Blco.[4] A height of about 35 meters and a diameter of about 1 meter may be attained by this tree. The fruits are about 3 centimeters wide, smooth, dark red, fleshy, and acid, and should make a good preserve.

This species is very common and widely distributed in the forests from northern Luzon to southern Mindanao, and it has been cultivated at the Lamao Experiment Station.

Kamachile, *Pithecolobium dulce* (Roxb.) Benth.[5] The tree reaches a height of 5 to 8 meters. This species is a native of tropical America but is now thoroughly naturalized in the Philippines where it is common and widely distributed. Large quantities of the bark are gathered for tanning purposes.

EXPERIMENTAL PROCEDURE

Solutions (2 per cent tannin content) were prepared from tanning extracts obtained from betel-nut kernel, and from black

[4] Brown, William H., Minor Products of Philippine Forests 2 (1920) 354.
[5] Tom. cit. 292.

wattle, kalumpit, and kamachile barks. They were heated on a steam bath for thirty minutes to pasteurize. Two-liter portions of each were separately inoculated with spores of the molds *Aspergillus niger* and *Penicillium glaucum*. Other 2-liter portions were exposed to the air and allowed to be infected with a mixture of molds existing under ordinary laboratory conditions.

The tannin content of the solutions was determined before inoculation, and periodic analyses were made afterwards.

In selecting aliquot portions of the solutions for analysis the flasks were rotated gently between the hands in order to get average samples, and care was taken to avoid disturbing the

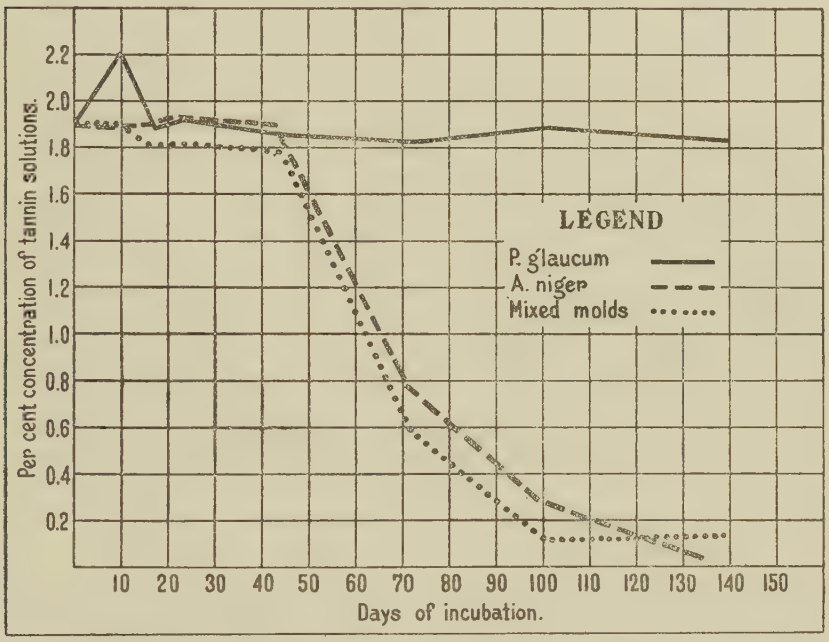

FIG. 2. Effect of molds on black-wattle solutions.

mold growth on the surface. Evaporation losses were made up with distilled water before samples were taken for analysis. The results are recorded in Tables 2 to 13.

In general the tannin content of the various extracts decreased, more or less, due to mold action. Usually the greatest decrease occurred after about forty days' exposure.

In comparing the pH values with the tannin content of the various extracts, we note certain relations.

A rise in the pH value was accompanied by a large decrease in tannin content. Acids inhibit the action of molds and the

destruction of tannins; consequently, in general, the less acid present the greater will be the decrease in tannin content. For instance, betel-nut extract inoculated with *A. niger* showed a rise in pH and a relatively high loss in tannin (Table 2). Mixed molds (Table 4) gave somewhat the same results.

When the betel-nut extract was inoculated with *P. glaucum* there was first a rise and later a decrease in pH, indicating increased acidity. There was also some loss in tannin (Table 3). The increase in acidity evidently inhibited the mold action but was not sufficient to stop it.

Treated with *A. niger* the betel-nut solution lost more tannin than treated with *P. glaucum* (Tables 2 and 3). The betel-nut extract was more resistant to *P. glaucum* than to *A. niger*.

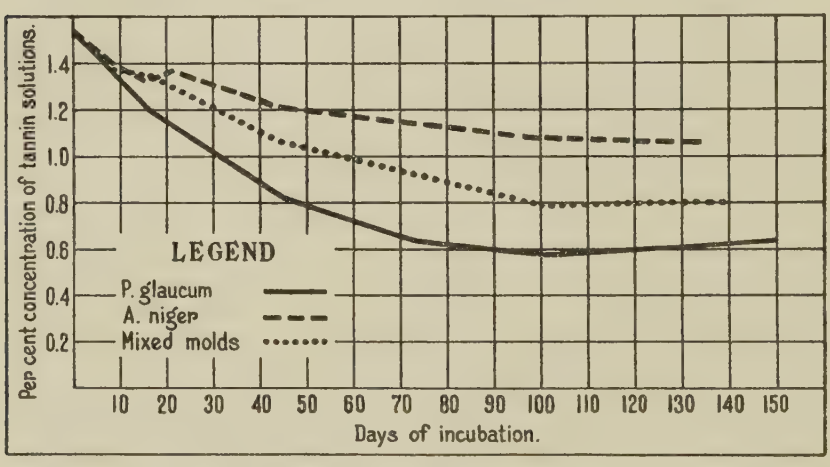

FIG. 3. Effect of molds on kalumpit solutions.

Inoculation of black-wattle extract with the mold *A. niger* gave a decrease in the pH value that was accompanied by a marked loss in tannin content (Table 5). In fact, after about four months of mold action hardly any tannin remained in the solution. In this case the increase in acidity failed to stop the mold action because the black-wattle tannin is evidently very susceptible to the action of the mold *A. niger*.

When the black-wattle tannin solution was inoculated with *P. glaucum* there was a comparatively large decrease in the pH (5.1 to 4.1). However, there was only a slight loss in tannin (Table 6). It would appear that black-wattle tannin is quite resistant to the mold *P. glaucum*.

The tannin content of the black-wattle extract decreased a great deal when the extract was exposed to the mixed molds in

the air, but there was not much change in the pH value (Table 7). Since *A. niger* is more abundant in the air than *P. glaucum* these results were to be expected in view of the data recorded in Tables 5 and 6.

In all the experiments with the kalumpit bark (Tables 8, 9, and 10) there was a large reduction in the pH. Here again, the increased acidity apparently inhibited the action of the molds. Kalumpit bark was more resistant to the action of *A. niger* than to that of *P. glaucum*. The mixed molds gave values that were about the average of the individual molds.

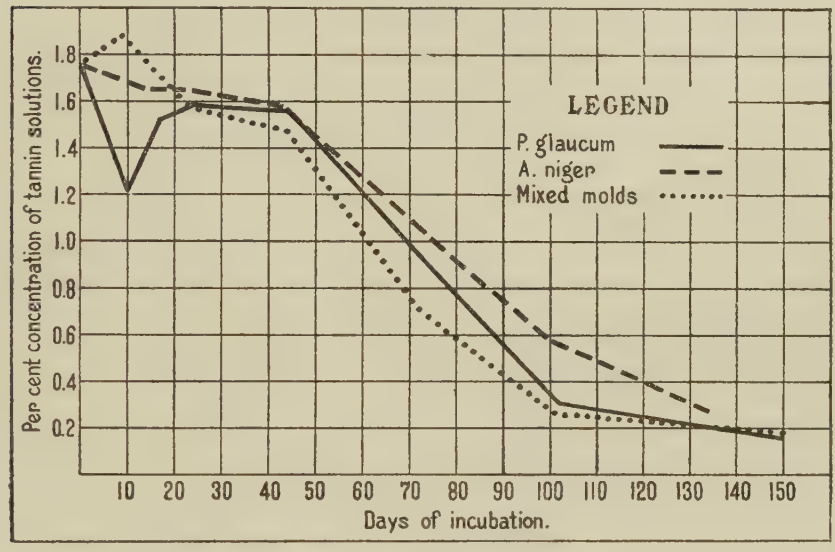

FIG. 4. Effect of molds on kamachile solutions.

The different molds gave the kamachile extract a slight increase in pH that was accompanied by an unusually large loss in tannin. This extract is very susceptible to mold action (Tables 11, 12, and 13).

The results recorded in the tables are illustrated graphically in the various charts (text figs. 1, 2, 3, and 4).

The barks used in this investigation were kindly presented to us by Mr. Arthur F. Fischer, director of the Bureau of Forestry.

SUMMARY

In this investigation a study was made of the effect of molds on some Philippine tanning liquors.

The molds used were *Aspergillus niger, Penicillium glaucum,* and mixtures consisting largely of these two.

The tannin liquors employed were extracts of betel-nut kernel and barks of black wattle, kalumpit, and kamachile.

In general the tannin content of the various extracts decreased, more or less, due to mold action.

A rise in the pH value of the extracts was accompanied by a large decrease in tannin content. Acids inhibit the action of molds and consequently the less the acid the greater the mold action.

Experiment showed that extracts of betel-nut and black wattle were very susceptible to the action of *A. niger* but were rather resistant to *P. glaucum.*

Kalumpit bark was more resistant to the action of *A. niger* than to that of *P. glaucum.*

Both molds had a deleterious effect on kamachile extract.

TABLE 1.—*Analysis of Philippine barks and betel-nut kernels.*

Sample.	Tannin.	Nontannin.	Purity.	Solids.		
				Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Betel-nut kernel; *Areca catechu* [a]	20.16	9.51	67.95	32.19	29.67	2.52
Black wattle; *Acacia decurrens* [b]	45.05	10.73	80.76	56.58	55.78	0.80
Kalumpit; *Terminalia edulis* Blanco [b]	34.11	7.23	82.51	43.17	41.34	1.83
Kamachile; *Pithecolobium dulce* (Roxb.) Benth.[b]	26.12	9.53	73.27	37.41	35.65	1.76

[a] Analysis made in the tanning laboratory, Bureau of Science.
[b] Analysis made by the Philippine Cutch Corporation, Zamboanga, P. I.

TABLE 2.—*Betel-nut tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.9	1.81	1.04	63.51	3.07	2.85	0.22
July 10	5.1	1.67	0.73	69.59	2.58	2.40	0.18
July 17	5.4	1.56	0.58	72.90	2.35	2.14	0.21
July 24	5.4	1.53	0.53	74.27	2.30	2.06	0.24
August 14	5.2	1.34	0.21	86.45	1.85	1.55	0.30
September 11	5.2	0.58	0.75	43.61	1.75	1.33	0.42
October 9	5.0	0.20	1.02	16.39	1.63	1.22	0.41
November 13	5.6	0.17	0.89	16.04	1.57	1.06	0.51

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 3.—*Betel-nut tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.9	1.81	1.04	63.51	3.07	2.85	0.22
July 12	5.1	1.75	0.74	70.28	2.74	2.49	0.25
July 19	5.1	1.68	0.62	73.04	2.54	2.30	0.24
July 26	5.5	1.66	0.57	74.44	2.45	2.23	0.22
August 16	5.0	1.47	0.51	74.24	2.23	1.98	0.25
September 13	4.6	1.39	0.47	74.73	2.11	1.86	0.25
October 11	4.5	1.33	0.50	72.68	2.09	1.83	0.26
November 19	4.3	1.11	0.63	63.79	2.03	1.74	0.29

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 4.—*Betel-nut tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.9	1.81	1.04	63.51	3.07	2.85	0.22
July 11	4.9	1.54	0.68	69.37	2.52	2.22	0.30
July 18	5.5	1.35	0.54	71.43	2.25	1.89	0.36
July 25	5.7	1.28	0.46	73.56	2.05	1.74	0.31
August 15	5.5	1.04	0.44	70.27	1.89	1.48	0.41
September 12	5.1	1.00	0.39	71.94	1.82	1.39	0.43
October 10	4.9	0.77	0.60	56.20	1.85	1.37	0.48
November 18	5.9	0.54	0.73	42.52	1.70	1.27	0.43

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 5.—*Black-wattle tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 10	5.1	1.89	0.64	74.70	2.76	2.53	0.23
July 17	5.1	1.90	0.45	80.85	2.58	2.35	0.23
July 24	5.4	1.93	0.37	83.91	2.52	2.30	0.22
August 14	5.5	1.89	0.26	87.91	2.33	2.15	0.18
September 11	4.8	0.78	0.50	60.94	1.80	1.28	0.52
October 9	4.7	0.29	0.32	47.54	1.62	0.61	1.01
November 13	4.7	0.04	0.38	9.52	1.65	0.42	1.23

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 6.—*Black-wattle tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 12	4.4	2.25	0.27	89.29	2.68	2.52	0.16
July 19	4.0	1.88	0.59	76.11	2.61	2.47	0.14
July 26	4.4	1.92	0.59	76.50	2.60	2.51	0.09
August 16	4.8	1.86	0.35	84.16	2.31	2.21	0.10
September 13	4.3	1.83	0.27	87.14	2.22	2.10	0.12
October 11	4.1	1.89	0.22	89.57	2.19	2.11	0.08
November 19	4.1	1.83	0.21	89.71	2.24	2.04	0.20

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 7.—*Black-wattle tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 11	5.1	1.90	0.49	79.50	2.55	2.39	0.16
July 18	5.5	1.81	0.33	84.58	2.39	2.14	0.25
July 25	5.7	1.81	0.29	86.19	2.34	2.10	0.24
August 15	5.8	1.78	0.24	88.12	2.20	2.02	0.18
September 12	4.7	0.57	0.66	46.34	1.95	1.23	0.72
October 10	4.6	0.12	0.76	13.64	1.87	0.88	0.99
November 18	4.8	0.13	0.60	17.81	1.87	0.73	1.14

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 8.—*Kalumpit tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.4	1.54	0.51	75.12	2.28	2.05	0.23
July 10	4.0	1.40	0.47	74.87	2.16	1.87	0.29
July 17	3.9	1.32	0.41	76.30	2.04	1.73	0.31
July 24	3.7	1.35	0.40	77.14	2.02	1.75	0.27
August 14	3.7	1.22	0.37	76.73	1.90	1.59	0.31
September 11	3.5	1.15	0.37	75.66	1.84	1.52	0.32
October 9	3.2	1.09	0.37	74.66	1.72	1.46	0.26
November 13	3.3	1.06	0.33	76.26	1.43	1.39	0.04

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 9.—*Kalumpit tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.4	1.54	0.51	75.12	2.28	2.05	0.23
July 12	3.8	1.34	0.41	76.57	2.00	1.75	0.25
July 19	3.6	1.20	0.36	76.92	1.88	1.56	0.32
July 26	3.4	1.11	0.32	77.62	1.84	1.43	0.41
August 16	3.3	0.83	0.34	70.94	1.56	1.17	0.39
September 13	3.2	0.64	0.39	62.14	1.45	1.03	0.42
October 11	3.1	0.58	0.45	56.31	1.35	1.03	0.32
November 29	3.3	0.64	0.50	56.14	1.38	1.14	0.24

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 10.—*Kalumpit tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.4	1.54	0.51	75.12	2.28	2.05	0.23
July 11	4.4	1.37	0.43	76.11	2.05	1.80	0.25
July 18	4.3	1.35	0.43	75.84	2.05	1.78	0.27
July 25	3.9	1.29	0.34	79.14	1.90	1.63	0.27
August 15	3.4	1.07	0.28	79.26	1.65	1.35	0.30
September 12	3.3	0.93	0.28	76.86	1.67	1.21	0.46
October 10	3.2	0.79	0.28	73.83	1.55	1.07	0.48
November 18	3.1	0.80	0.30	72.73	1.50	1.10	0.40

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 11.—*Kamachile tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 10	5.9	1.70	0.83	67.19	2.91	2.53	0.38
July 17	6.3	1.65	0.79	67.62	2.86	2.44	0.42
July 24	6.3	1.65	0.80	67.35	2.83	2.45	0.38
August 14	6.2	1.59	0.79	66.81	2.79	2.38	0.41
September 11	5.9	1.08	1.29	45.57	2.60	2.37	0.23
October 9	5.6	0.59	1.80	24.69	2.54	2.39	0.15
November 13	5.9	0.28	2.15	11.52	2.51	2.43	0.08

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 12.—*Kamachile tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 12	5.7	1.23	1.23	50.00	2.84	2.46	0.38
July 19	5.8	1.53	0.78	66.23	2.75	2.31	0.44
July 26	5.7	1.59	0.77	67.37	2.72	2.36	0.36
August 16	6.1	1.56	0.78	66.66	2.62	2.34	0.28
September 13	6.1	0.93	1.46	38.91	2.60	2.39	0.21
October 11	5.8	0.31	2.08	12.97	2.56	2.39	0.17
November 29	5.7	0.17	2.35	6.75	2.62	2.52	0.10

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 13.—*Kamachile tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 11	5.9	1.89	0.51	78.75	2.70	2.40	0.30
July 18	6.4	1.73	0.77	69.20	2.64	2.50	0.14
July 25	6.1	1.58	0.70	69.30	2.51	2.28	0.23
August 15	5.8	1.47	0.75	66.22	2.48	2.22	0.26
September 12	5.8	0.71	1.56	31.28	2.44	2.27	0.17
October 10	5.5	0.27	2.07	11.54	2.48	2.34	0.14
November 29	5.8	0.18	2.25	7.41	2.64	2.43	0.21

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Effect of molds on betel-nut solutions.
2. Effect of molds on black-wattle solutions.
3. Effect of molds on kalumpit solutions.
4. Effect of molds on kamachile solutions.

PHILIPPINE ANNATTO DYE AS A COLORING AGENT

By Simeona Santiago Tanchico and Augustus P. West
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THREE PLATES

The bulk of the dyes that are now used commercially are synthetic products.[1] There are, however, a few natural dyes [2] that are still employed. One of the most important of these is annatto, which is obtained from the seeds of the annatto tree. This tree is known botanically as *Bixa orellana* Linn. It is a native of tropical America and has been introduced into many other countries. For more than a hundred years the tree has been cultivated in India, where the dye has been used for various purposes.[3] Years ago annatto was introduced into the Philippines, where it is grown in and about towns, and is called, in Tagalog, *achuete.*

The annatto tree reaches a height of 4 to 6 meters. The flowers are white to pinkish in color. The seeds are inclosed in capsules that are somewhat rounded and covered with soft bristles. The seeds are about the size of grapeseeds and are pyramidal in shape. They are covered with a soft resinous pulp that has an attractive vermilion color. This pulp surrounding the seeds contains the annatto dye.

Formerly annatto was employed to some extent for dyeing certain textiles. It is not a fast dye, and consequently, like most other natural dyes, it has been replaced by synthetic colors. However, it is still used for coloring butter and cheese.

In certain districts along the Amazon River the Indian families make ornamental pottery and drinking cups which they sell to traders and travelers. These products are often painted rather cleverly with different colors. The red tints are made with annatto dye.[4]

[1] Cain and Thorpe, Synthetic Dyestuffs. Revised by J. F. Thorpe and R. P. Linstead (1933).

[2] Perkin, A. G., and A. E. Everest, Natural Organic Coloring Matters (1918).

[3] Watt, G., Dictionary of the Economic Products of India 1 (1891) 454.

[4] Bates, H. W., The Naturalist On the River Amazons (1931) 122.

In the Philippines one can usually find annatto seeds for sale in the larger markets. The seeds are used mostly for coloring local foods.

Annatto is exported from Jamaica, Ecuador, Brazil, and neighboring regions, and also from India and Java, but not from the Philippines.

According to Thorpe: [5]

> Annatto comes into the market in the form of cakes, and among the different varieties Cayenne annatto is the most esteemed, and is considered to be the richest in colouring matter. It should contain from 10 to 12 p.c. of the pure dye, and not more than 5 p.c. of ash, whereas the amount of colouring matter in the Bengal product is frequently lower than 6 p.c.

Annatto dye contains two coloring matters. It consists mostly of bixin (cinnabar red) together with some orellin (yellow). Etti,[6] who first prepared crystallized bixin, proposed the formula $C_{28}H_{34}O_5$ for it. There has been some controversy in chemical literature as to the correctness of this formula, and some investigators have suggested somewhat different formulas.[7]

Occasionally the Bureau of Science receives letters requesting recipes in which annatto dye is one of the constituents. For this extension service we have worked out some recipes that serve to illustrate how this dye may be used.

EXPERIMENTAL PROCEDURE

Various methods have been suggested for extracting the dyestuff contained in the pulp surrounding the annatto seeds. One of the simplest methods is to place the seeds in a mortar, add some water and stir the seeds around with a pestle. The colored solution is poured off and the trituration process repeated until no more color is extracted. The combined water solutions are acidified with 4 per cent acetic acid, or vinegar. This precipitates the crude dye which is obtained by pouring off the supernatant liquid or by filtering.

Bixin is the more useful coloring matter in the crude dye and is obtained conveniently by Zwick's method.[8] The seeds are extracted for twenty-four hours with boiling chloroform. The extract is then poured off from the seeds and the excess solvent

[5] Thorpe, E., Dictionary of Applied Chemistry 1 (1927) 332.
[6] Ber. Deut. Chem. Gesell. 7 (1874) 446; 11 (1878) 864.
[7] Thorpe, E., Dictionary of Applied Chemistry 1 (1927) 333.
[8] Thorpe, E., op. cit. 332.

removed by distilling. The concentrated solution is evaporated to dryness and the residue is treated several times with petroleum ether to remove oily constituents. The red powder that remains is crystallized from chloroform giving crystals that melt at 165° C.

The red powder, or crystals, dissolved in concentrated sulphuric acid, gives a solution with a bright blue color, and on dilution with water a green precipitate is obtained (test for bixin).

Kolhaas and Koppel [9] have recently suggested another method for producing annatto paste in which the dye is extracted with dilute alkali.

COMMERCIAL PRODUCTS

Although the recipes that follow have given satisfactory results they are presented as suggestions rather than specific directions. The exact quantity of the individual ingredients in each recipe can usually be varied to some extent. Again the more costly constituents might be replaced by substitutes that are cheaper if quality is not a matter of primary importance.

FLOORWAX AND FURNITURE POLISH

Materials:	
Beeswax, g	80
Carnauba wax, g	80
Paraffin, g	80
Tallow, g	80
Hercules rosin, g	80
Turpentine (colored with annatto), cc	500

The colored turpentine is prepared by treating 250 grams of annatto seeds with 1,000 cubic centimeters of turpentine. Allow the mixture to stand overnight, then pour off the supernatant liquid from the seeds. This is the stock solution of annatto-colored turpentine that is used for coloring.

The solid materials (waxes, paraffin, tallow, and rosin) are melted together in a casserole over a small flame. The flame is then extinguished and the annatto-colored turpentine added. The mixture is stirred thoroughly and while still hot is poured into containers and cooled quickly. The stoppers of the containers should fit tightly to prevent loss of solvent.

The polish should be applied with a soft cloth and the polished surface rubbed briskly to produce a brilliant luster.

[9] Indische Mercuur 58 (1935) 525.

SHOE POLISH (FOR BROWN OR TAN SHOES)

Materials:

Carnauba wax, g	50
Beeswax, g	100
Paraffin, g	80
Tallow, g	20
Annatto-colored turpentine, cc	300
Nitrobenzene, cc	10

The annatto-colored turpentine is prepared as in the recipe for furniture polish.

The solid materials are melted together in a casserole over a small flame. When the materials are completely melted the flame is extinguished and the annatto-colored turpentine added. The mixture is now stirred thoroughly, and when it is somewhat cool the nitrobenzene is added and the product poured into containers.

The polish should be applied with a soft cloth and the polished surface rubbed briskly to produce a brilliant luster.

NAIL GLOSS

Materials:

Celluloid, g	50
Amyl acetate, cc	450
Acetone, cc	450
Acetone saturated with annatto, cc	1

The celluloid is first dissolved in amyl acetate. Acetone is now poured into this solution, after which there is added about 1 cubic centimeter of a solution of acetone saturated with annatto.

This gloss should be applied with a small camel's hair brush. Finger nails treated with this gloss acquire a deep red color.

Scrap photo films can be used in place of celluloid but they should first be cleaned by treating with dilute alkali solution and washed well with water.

A saturated solution of annatto dye dissolved in acetone may be prepared by treating about 0.5 gram of annatto dye with 20 cubic centimeters of acetone.

The gloss may be removed by washing with acetone.

BRASS LACQUER

Materials:

Celluloid, g	50
Amyl acetate, cc	400
Acetone, cc	400
Acetone saturated with annatto, cc	1

The brass lacquer is made in the same manner as the nail gloss. Various shades may be obtained by varying the amount

of colored solution or the color may be omitted entirely. It may be applied with a soft brush or used as a spray.

If the liquid becomes too thick due to evaporation of the solvents (amyl acetate or acetone) it may be diluted with either of them.

When vases and other brass articles are allowed to stand around as ornaments they soon lose their brightness and luster and are no longer very attractive. If new or polished brassware is first treated with this preparation it retains its original brilliant appearance for a considerable length of time.

HAIR OIL

Macerate the annatto seeds in colorless and odorless coconut oil. Use sufficient seeds to obtain the desired color. When all the dye is dissolved remove the seeds by filtering and add a small quantity of any desired perfume.

WOOD STAIN

Annatto dye dissolved in acetone, chloroform, or ethyl acetate gives a dark red solution that can be used for staining wood. This colored solution may also be incorporated with an alcoholic solution of shellac if a colored shellac varnish is desired.

SUMMARY

The annatto tree, *Bixa orellana* Linn., is a native of tropical America and has been introduced into many other countries including the Philippines.

The seeds of the annatto tree are covered with a soft resinous pulp that contains a red dye known as annatto. Various methods have been suggested for extracting this dye.

Annatto is one of the very few natural dyes that is still used commercially. It is employed mostly for coloring butter and cheese. Local foods are often colored with it in the Philippines.

In order to illustrate how annatto dye may be used recipes for making the following products were worked out: Floorwax, furniture and shoe polish, nail gloss, brass lacquer, hair oil, and wood stain.

ILLUSTRATIONS

PLATE 1

Annatto tree (*Bixa orellana* Linn.) growing in Manila.

PLATE 2

FIG. 1. Annatto buds and flower.
2. Annatto capsules.

PLATE 3

FIG. 1. Annatto capsule opened showing immature seeds.
2. Mature annatto seeds.

PLATE 1.

PLATE 2.

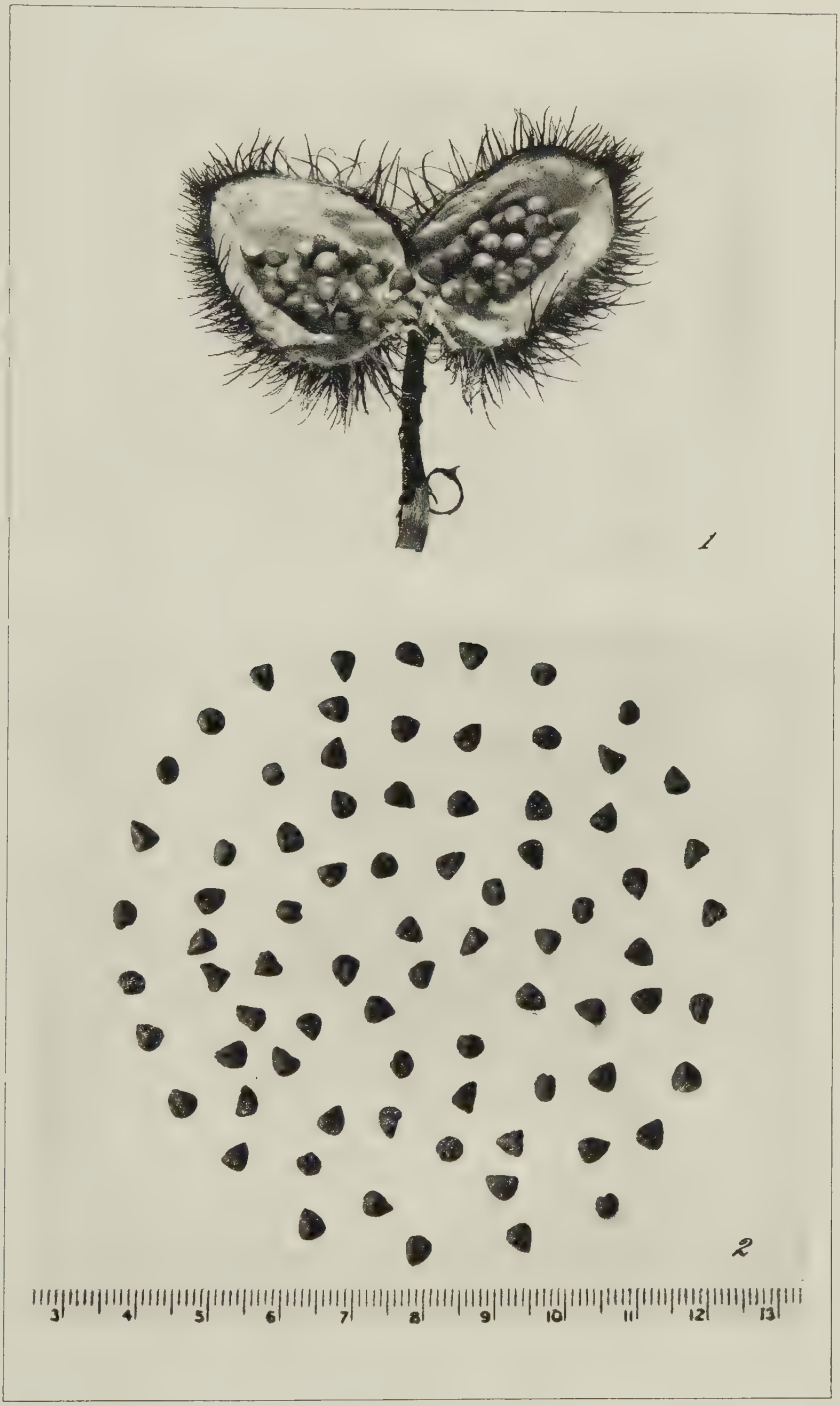


PLATE 3.

COMPOSITION OF PHILIPPINE PHYSIC-NUT OIL

By Aurelio O. Cruz and Augustus P. West

Of the Bureau of Science, Manila

THREE PLATES

Recently the Bureau of Science received several requests for information concerning the constituents of physic-nut oil. Experiments on this oil have been carried out in various laboratories, but the results were not concordant. To determine the exact composition of physic-nut oil the present investigation was therefore undertaken.

Physic-nut oil is obtained from the seeds of a small tree that grows to a height of 2 to 5 meters. This tree is a native of tropical America and is known botanically as *Jatropha curcas* Linn. For many years it has been grown in other countries, including the Philippines, where it is usually cultivated in and about towns to serve as a hedge plant. It is called in Tagalog *tubang-bakod. Tuba* is a name given to many plants of this family that are used for poisoning fish, and *bakod,* is the Tagalog word for "hedge" or "fence." Hence the name túbang-bakod. The seeds of this plant are inclosed in capsules that are mostly rounded.

The constants and characteristics of physic-nut oil have been determined by various investigators. The oil has strong purgative properties when taken internally, and it also contains a toxic substance.[1] It has been used medicinally in India[2] as a remedy for itch. In Portugal[3] it has been employed for soap making and as an illuminant. In the Philippines the oil is not extracted from the seeds.

[1] Anon., Bull. Imp. Inst. 17 (1919) 433. Heim, F., and J. Rullier, Bull. del'office colonial 12 (1919) 96.

[2] Watt, G., Dictionary of the Economic Products of India 4 (1890) 546.

[3] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 2 (1922) 2141.

Samples of physic-nut oil obtained from different countries gave iodine values [4] that varied from about 94 to 106. This oil would therefore be classified as a semidrying oil.

When the glycerides of physic-nut oil are converted into acids, these mixed acids, according to Lewkowitsch,[5] have about equal amounts of the unsaturated oleic and linolic acids in addition to the saturated acids they contain. Soliven [6] reported 35.21 per cent oleic and 49.28 per cent linolic acid in the mixed acids. Kafuku, Hata, and Fujikawa [7] found that the total mixed acids contained 53.20 per cent oleic and 22.80 per cent linolic acid. Experiments performed by Francois and Droit [8] indicated that the mixed acids have about three and a half times as much oleic as linolic acid.

From the inconsistent data recorded in the literature it is evident that the exact composition of physic-nut oil is still an open question.

EXPERIMENTAL PROCEDURE

The physic-nut seeds used in this investigation were collected near Magalang, Pampanga Province, Luzon. They were found to have 34.3 per cent of hulls and 65.7 per cent of kernels. A sample of the kernels extracted with ether gave 46.5 per cent of oil, hence the oil in the whole seeds amounted to 30.6 per cent. The seeds had a moisture content of 20.0 per cent; calculated on a moisture-free basis the whole seeds contained 38.2 per cent of oil.

When tested in the Bureau of Science by the Division of Tests and Standards the hulls gave a heating value of 4,653 calories per gram. This is somewhat higher than the result obtained for common Philippine firewood which gave 4,633 calories per gram.

The physic-nut oil, obtained by cold-pressing the crushed kernels, was filtered to eliminate most of the solid material. The

[4] Grimme, L. I. C., Zeit. deut. Oel-Fett-Ind. 41 (1921) 513. Anon., Bull. Imp. Ins. 19 (1921) 288. L., Mat. grasses 14 (1922) 6099. Soliven, F. A., Philip. Agr. 16 (1928) 587. Smith, T. J., Chemist and Druggist 112 (1930) 746. Kafuku, V. K., C. Hata, and M. Fujikawa, Journ. Chem. Soc. Japan 53 (1932) 1115. Droit, S., Bull. mat. grasses inst. colonial Marseille 16 (1932) 270. Francois, M. T., and S. Droit, Bull. Soc. Chim. 53 (1933) 728; 1564. Adriaens, L., Mat. grasses 28 (1936) 10786; 10813.

[5] Chemical Technology and Analysis of Oils, Fats, and Waxes 2 (1922) 241.

[6] Philip. Agr. 16 (1928) 593.

[7] Journ. Chem. Soc. Japan 53 (1932) 1115.

[8] Bull. Soc. Chim. 53 (1933) 728.

oil was then purified by treating successively with 2 per cent kieselguhr, suchar, and talcum powder. This treatment removes vegetable fibers and colloidal matter and produces a brilliantly clear oil that is only slightly yellow.

The oil cake that remains after expelling the oil cannot be used as cattle food because it contains a purgative substance that is toxic. Analysis [9] gave the following results (Table 1).

TABLE 1.—*Composition of physic-nut oil cake.*

Constituent.	Per cent.
Moisture	6.63
Ash	8.87
Oil	14.14
Protein	49.30
Crude fiber	3.45
Carbohydrates (by difference)	17.01

In Table 2 is given the fertilizer value [10] of physic-nut oil cake. It has a high value as a fertilizer and is about as rich in nitrogen and phosphorus as castor-seed cake.

TABLE 2.—*Fertilizer constituents in physic-nut oil cake.*

Constituent.	Per cent.
Nitrogen (N_2)	8.23
Phosphoric anhydride (P_2O_5)	4.71
Potash (K_2O)	0.25
Moisture	8.05

The physical and chemical constants of physic-nut oil are given in Table 3.

TABLE 3.—*Physical and chemical constants of physic-nut oil.*

Specific gravity at 30°/4° C.	0.9082
Refractive index at 30° C.	1.4665
Iodine number (Hanus)	94.8
Saponification value	192.4
Unsaponifiable matter (per cent)	0.45
Acid value	5.1
Saturated acids, determined (per cent) [a]	17.37
Unsaturated acids plus unsaponifiable matter, determined (per cent)	77.90
Saturated acids, corrected (per cent)	16.82
Unsaturated acids, corrected (per cent) [b]	78.00
Iodine number of unsaturated acids	111.00

[a] Due to the incomplete separation by the lead-salt-ether method the saturated acids, as determined, contained 0.55 per cent unsaturated acids.

[b] Corrected for unsaponifiable matter and also for the percentage of unsaturated acids contained in the saturated acids.

[9] Analysis was made by Miss Gloria Cortes of the Bureau of Science.

[10] Analysis was made by Mr. R. Isidro of the Philippine Soil Surveys.

The saturated and unsaturated acids that occur as glycerides in Philippine physic-nut oil were separated by the lead-salt-ether method [11] in accordance with the suggestions of Baughman and Jamieson.[12] The results are recorded in Table 4.

TABLE 4.—*Separation of saturated acids from the unsaturated acids in Philippine physic-nut oil by the lead-salt-ether method.*

Experiment No.	Oil used.	Unsaturated acids.	Saturated acids.	Unsaturated acids (determined).	Saturated acids (determined).	Unsaturated acids (corrected).[a]	Saturated acids (corrected).
	g.	*g.*	*g.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	18.0477	14.1066	3.1020	78.16	[b] 17.18	78.20	16.69
2	17.1276	13.2985	3.0067	77.64	17.55	77.79	16.95
Mean				77.90	17.37	78.00	16.82

[a] Unsaturated acids (unsaponifiable matter) removed; iodine number (Hanus) 111.0.
[b] Iodine number (Hanus) 3.2.
[c] Iodine number (Hanus) 3.8.

Unsaturated acids.—The unsaturated acids separated from physic-nut oil by the lead-salt-ether method were treated with bromine and converted into their bromo-derivatives.[13]

No ether-insoluble hexabromide was obtained, thus showing the absence of linolenic acid. The composition of the mixed unsaturated acids, which occur as glycerides in physic-nut oil, was calculated from the iodine number of the unsaturated acids. The results are recorded in Table 5. There are also included the calculated percentages of glycerides corresponding to these individual unsaturated acids.

TABLE 5.—*Composition of the unsaturated acids of physic-nut oil and the glycerides corresponding to these acids.*

Acid.	Mixture of unsaturated acids.	Original oil.	Glycerides in original oil.
	Per cent.	*Per cent.*	*Per cent.*
Linolic	22.89	17.85	18.65
Oleic	77.11	60.15	62.86
Total	100.00	78.00	81.51

[11] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 556.

[12] Cotton Oil Press 6 No. 1 (1922) 41. Journ. Am. Chem. Soc. 42 (1920) 2398.

[13] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 585.

Saturated acids.—The saturated acids were separated from physic-nut oil by the lead-salt-ether method and esterified with methyl alcohol. The mixed acids were dissolved in methyl alcohol and saturated with dry hydrogen chloride gas. The mixture was then heated on a water bath (reflux) for fifteen hours, after which it was treated with water and the ester layer separated. The esters were dissolved in ether and the ethereal solution washed with sodium carbonate solution and afterwards with water. The ethereal solution was dehydrated with anhydrous sodium sulphate, filtered, and the ether removed by distilling. The impure esters which were yellow, were distilled under diminished pressure. A preliminary distillation at 5 millimeters pressure was made. The esters were redistilled at 4 millimeters pressure. Data on the distillation of the esters are given in Tables 6 and 7.

TABLE 6.—*First distillation of the methyl esters of the saturated acids; pressure 5 millimeters; 96.9878 grams of esters distilled.*

Fraction.	Temperature.	Weight.
	°C.	g.
A	174–177	16.1691
B	177–180	36.5653
C	180–183	15.2844
D	183–186	11.0956
E	186–194	9.5761
F	194–204	6.3588
Residue		1.7400
Total		96.7893

TABLE 7.—*Second distillation of the methyl esters of the saturated acids; pressure 4.0 millimeters; 96.7893 grams of esters redistilled.*

Fractions.		Temperature.	Weight.
From first distillation.	Second distillation.		
		°C.	g.
A and B	1	170–173	19.0076
C	2	173–176	20.5963
D	3	176–179	16.6208
E	4	179–182	10.4567
F and residue	5	182–185	15.6619
	6	185–188	7.9899
	7	188–204	5.2426
	Residue		0.6512
Total			96.2270

In Table 8 are given the analyses of fractions obtained in the second distillation of methyl esters. From these data there were calculated the amounts of the individual acids corresponding to the methyl esters contained in the various fractions. The results are recorded in Table 9 and were computed in accordance with the procedure used by Baughman and Jamieson [14] in their investigations of vegetable oils.

TABLE 8.—*Analyses of fractions obtained in the second distillation of the mixed methyl esters.*[a]

Fraction.	Iodine number.	Saponification value.	Mean molecular weight of mixed esters.	Composition of mixed esters.		Mean molecular weight of saturated esters.
				Saturated.	Unsaturated.	
				Per cent.	*Per cent.*	
1	2.0	209.5	267.8	98.11	1.89	267.3
2	2.9	207.4	270.5	97.26	2.74	269.8
3	5.0	202.4	277.2	95.27	4.73	276.4
4	7.3	199.8	280.8	93.09	6.91	279.7
5	9.5	193.9	289.3	91.01	8.99	288.7
6	10.2	191.0	293.7	90.35	9.65	293.6
7	9.7	185.9	301.8	90.82	9.18	302.4

[a] Calculated iodine number of unsaturated methyl esters 105.7; calculated saponification value of unsaturated methyl esters 189.8.

TABLE 9.—*Saturated acids corresponding to methyl esters in each fraction.*

Fraction.	Acid.							
	Myristic.		Palmitic.		Stearic.		Arachidic.	
	Per cent.	*g.*	*Per cent.*	*g.*	*Per cent.*	*g.*	*Per cent.*	*g.*
1	9.89	1.8800	83.07	15.7896				
2	1.63	0.3357	90.58	18.6561				
3			70.65	11.7426	19.79	3.2893		
4			58.64	6.1318	29.78	3.1140		
5			29.59	4.6344	57.00	8.9273		
6			14.38	1.1489	71.65	5.7248		
7					73.88	3.8732	12.73	0.6674
Residue [a]								0.6233
Total		2.2157		58.1034		24.9286		1.2907

[a] Residue assumed to be methyl arachidate.

[14] Journ. Am. Chem. Soc. 42 (1920) 156; 1197.

Table 10 gives the composition of the mixed saturated acids and the glycerides in the original oil corresponding to these acids.

TABLE 10.—*Saturated acids.*

Acid.	Mixture of saturated acids.[a]			Glycerides in original oil.
	Weight.	Composition.	Proportions in original oil.	
	g.	*Per cent.*	*Per cent.*	*Per cent.*
Myristic	2.2157	2.56	0.43	0.45
Palmitic	58.1034	67.14	11.29	11.84
Stearic	24.9286	28.81	4.85	5.07
Arachidic	1.2907	1.49	0.25	0.26
Total	86.5384	100.00	16.82	17.62

[a] When separated from physic-nut oil the corrected percentage of saturated acids was 16.82.

The composition of Philippine physic-nut oil is recorded in Table 11. As shown by the data the oil consists principally of oleic, linolic, and palmitic glycerides. The amount of oleic glyceride is remarkably large. This oil is suitable chiefly for making soap.

The theoretical saponification value of physic-nut oil, calculated from our results, is 191.2. The saponification value as determined by experiment was found to be 192.4. The calculated value checks very well with the experimental result.

TABLE 11.—*Composition of Philippine physic-nut oil.*

Constituent.	Per cent.
Glycerides of:	
Unsaturated acids—	
Oleic	62.86
Linolic	18.65
Saturated acids—	
Myristic	0.45
Palmitic	11.84
Stearic	5.07
Arachidic	0.26
Unsaponifiable matter	0.45
Total	99.58

SUMMARY

Jatropha curcas is a small tree that is grown in the Philippines and usually cultivated in and about towns to serve as a hedge plant.

The oil obtained from the seeds of this tree is known as physic-nut oil. When taken internally it has strong purgative properties and in some countries it has been used medicinally. It has also been employed for making soap and as an illuminant.

Physic-nut oil consists principally of glycerides of oleic, linolic, and palmitic acids. The amount of oleic glyceride contained in the oil is remarkably large.

ILLUSTRATIONS

PLATE 1

Physic-nut tree (*Jatropha curcas* Linn.), growing near Manila.

PLATE 2

Physic-nut capsules.

PLATE 3

FIG. 1. Physic-nut flowers.
2. Mature physic-nut seeds (natural size).
3. Physic-nut capsule opened showing seeds.

PLATE 1.

PLATE 2.

PLATE 3.

AN IMPROVED JONES REDUCTOR

By Rollin G. Meyers
Chemist, United States Navy Yard, Cavite, Philippine Islands

ONE PLATE

The recent use of fretted glass instead of asbestos for filtration, as for example in the Gooch crucible, suggested the idea of applying it to the Jones reductor for iron determinations.

Whether the ordinary form of the Jones reductor is used, or, better, the design favored by Hillebrand and Lundell,[1] some pad near the bottom of the tube must be provided; for it is necessary to hold the column of 20-mesh zinc securely in the reductor and prevent any of the metal from being carried into the suction flask. Filter plates do not always fit securely, and usually the construction of this pad requires some little time. To avoid these objectionable features there is substituted an integrated, fretted-glass filter pad. The pad should be of sufficient compactness to retain the zinc particles but not too dense to retard the passage of the solutions through the reductor.

The design of the reductor (Plate 1) shows the position of the fretted-glass filter pad, and is similar in general features to that favored by Hillebrand and Lundell, but differs in that the main stopcock is placed at the left instead of the right. This change it is believed facilitates the manipulation by permitting an easier use of both hands when the main and lateral stopcocks are used at the same time. The dimensions given in the drawings are tentative.

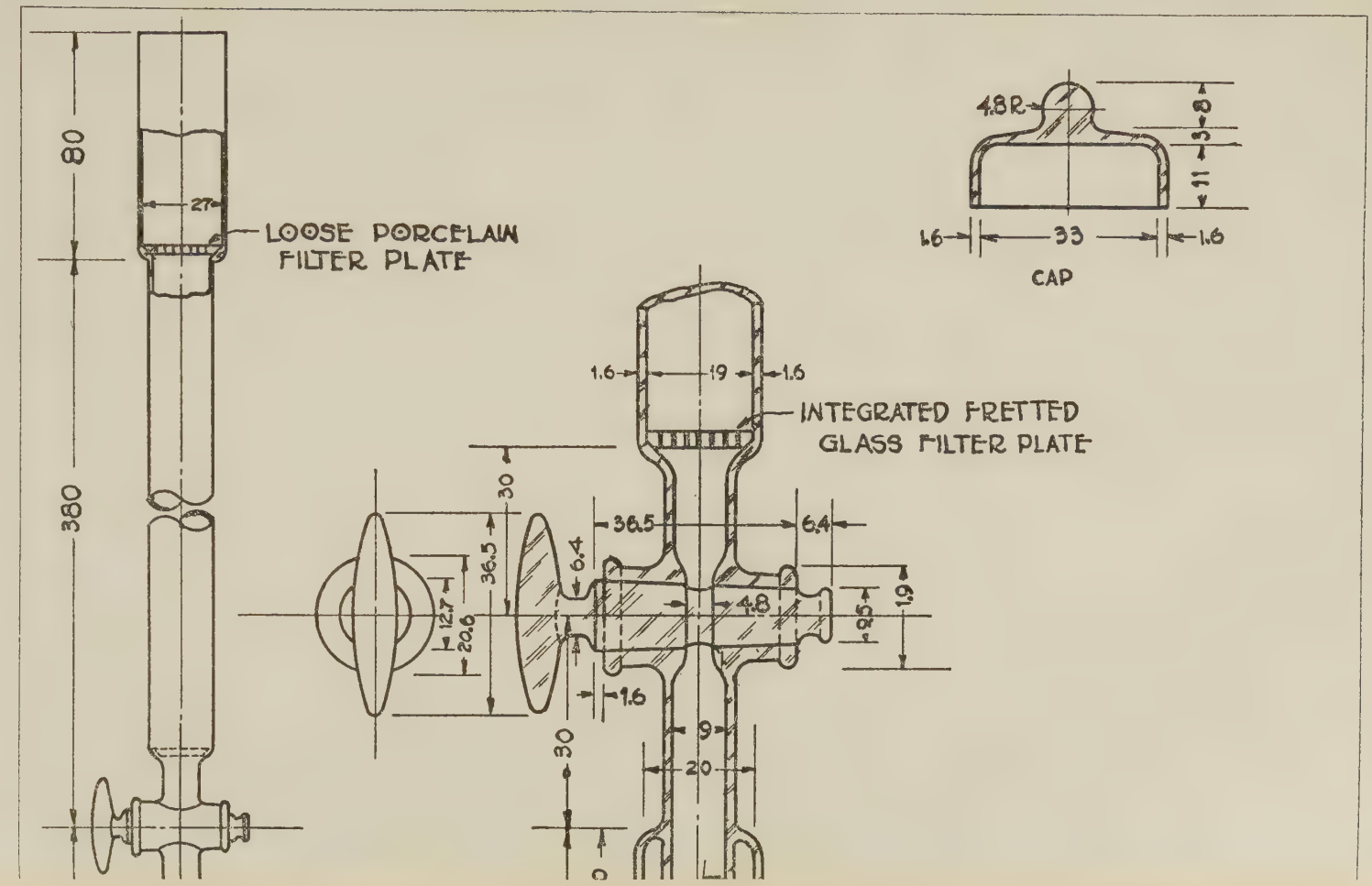
[1] Applied Inorganic Analysis (1934) 100.

ILLUSTRATION

PLATE 1

FIG. 1. Jones reductor with Meyers modification of integrated fretted-glass filter plate. About 0.4 actual size.

2. Detailed view of the fretted-glass filter and stopcocks. About 0.8 actual size. Dimensions are in millimeters on both figures.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LOOSE PORCELAIN FILTER PLATE
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INTEGRATED FRETTED GLASS FILTER PLATE
30
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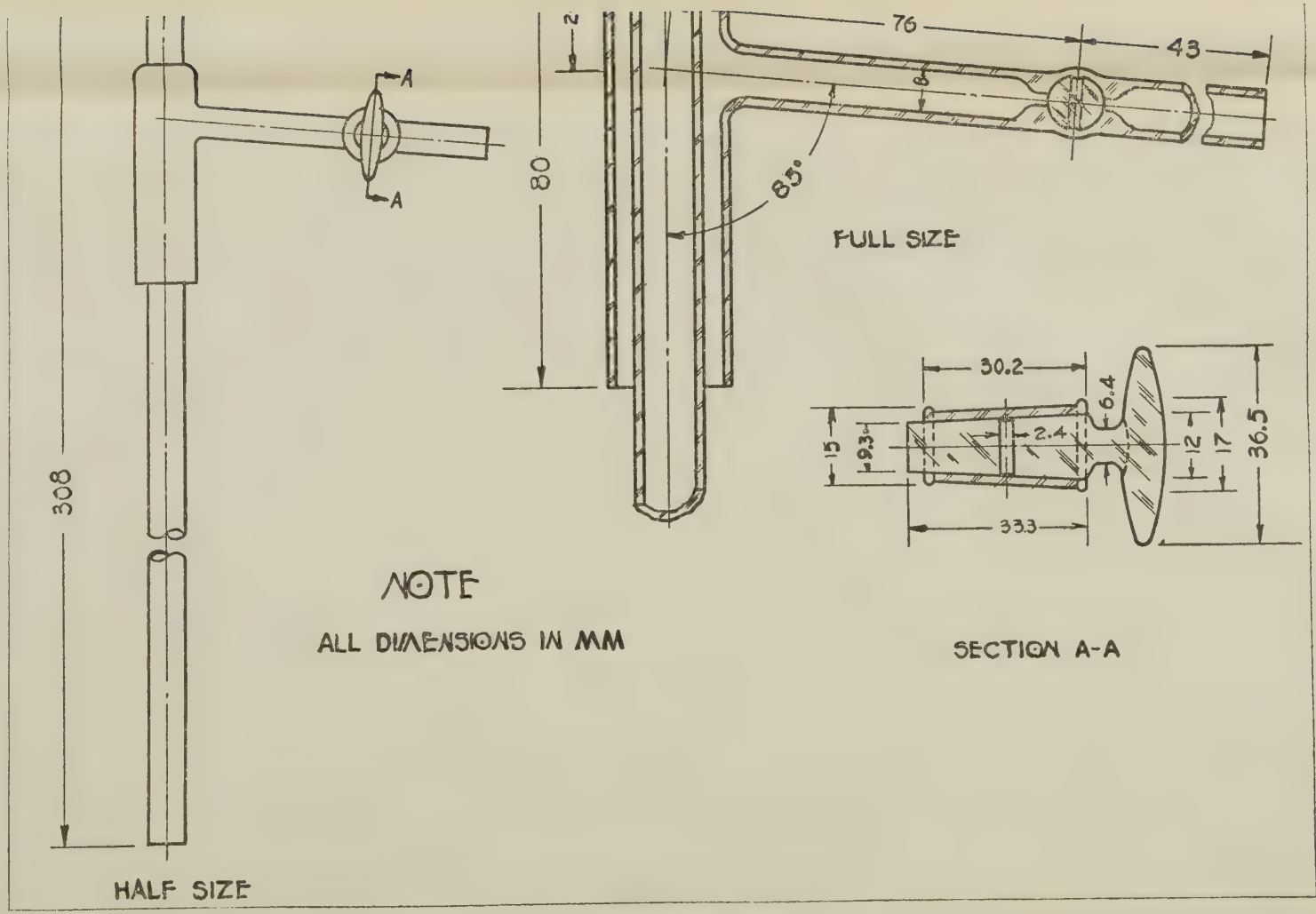
A
A
308
80
2
76
43
8
85°
FULL SIZE
30.2
6.4
2.4
15
9.3
12
17
36.5
33.3
NOTE
ALL DIMENSIONS IN MM
SECTION A-A
HALF SIZE

PLATE 1.

FLORAL MECHANISM IN STERCULIA APETALA (JACQUIN) KARSTEN [1]

By José B. Juliano
Of the College of Agriculture, University of the Philippines, Los Baños
and
Eduardo Quisumbing
Of the Bureau of Science, Manila

FOUR PLATES

One of the most interesting and fascinating problems in botany is the peculiar biological behavior of floral organs of many angiosperms. Some of these flowers possess structures well adapted to insure pollination, while others almost lack the structural and peculiar organization essential to reproduction. Several imported shade trees, *Sterculia apetala* (Jacq.) Karsten (*S. carthaginensis* Cav.), now growing at the College of Agriculture, University of the Philippines, Los Baños, Laguna, have been producing an abundance of flowers each year for several years, and surprisingly enough few fruits or none have developed from them after any blooming period. Because of this apparent paucity of the fruits any observation on the floral behavior is of interest and worthy of record.

This large, graceful, and stately tree (Plate 2) is a native of Panama(4) and is found from southern Mexico to the West Indies and northern South America.[2] It is known there as *panama;* in Guatemala, Salvador, and Honduras, *castaño;* in Tabasco, *bellota;* in Columbia, *camajon;* and in Cuba, *camaruca.*

Its leaves are large, deciduous, digitately 3- to 5-lobed, more or less peltate, coriaceous, shining green above and soft stellate-tomentose below. Shedding of its leaves usually takes place in the middle or even as late as the later part of January and lasts for a month or so. Simultaneous with the shedding of its leaves, new leaf initials are formed at the apices of the branches. At

[1] Experiment station contribution, No. 1145. Read before the Los Baños Biological Club, September 24, 1936.

[2] The writers have failed to determine the exact date of introduction of these trees on the campus from the records of the Department of Agronomy, College of Agriculture.

the axils of the juvenile leaves, inflorescence initials are differentiated at the four to five basal young leaves. Active growth of the leaf and inflorescence initials takes place only when all of its leaves are nearly shed (Plate 3), this lasting for about a week or so, whence the tree regains its former verdure and the inflorescences become well developed (Plate 4).

The inflorescence, which is axillary, is a large, spreading panicle, bearing numerous pedicellate, bell-shaped, polygamous (andromonœcious) flowers. The hermaphrodite, or perfect, flowers (Plate 1, fig. 8), are less in number than the males (Plate 1, fig. 9) and are the first to mature. Neither flower possesses distinct petals or sepals, and instead each is provided with a 5-lobed, bell-shaped perianth, studded with pinkish to reddish woolly shaggy hairs on the outside, and villous within. Sometimes the perianth may be reddish and woolly inside, dark red and greenish yellow without. Each flower usually measures from 1.8 to 2.5 centimeters in diameter, and is provided with a terete pedicel about 0.8 to 1.2 centimeters in length. At the central inner portion of the perianth surrounding the stalk, which bears either the pistil and stamens or stamens alone, is a yellowish circular disc whereon deposits of droplets of nectar can be detected before anthesis, and these attract insects during the early forenoon.

In the hermaphrodite flower the stipitate pistil is hairy, 4- or 5-carpelled, 4- or 5-celled; style connate; stigma radiate. The anthers are borne in groups of two or three on a ring around the base of the ovary (Plate 1, figs. 10–12) and are more or less provided with very short stubby filaments. The anthers are bilobed, and dehiscence is longitudinal.

The staminate flower, which develops much later than the hermaphrodite, is provided with a terete hairy stalk borne at the center of the perianth and is enlarged at its apex, whereon the anthers are borne on a common disc (Plate 1, fig. 9). Surrounded by the anthers and usually inconspicuous is a rudimentary pistil.

The fruit, which seldom sets, is borne in a cluster of five podlike carpels, about 10 centimeters long and contains large brown chestnutlike seeds. Its interior is covered with stiff brown bristles that may penetrate the flesh and may cause irritation.

The trees on the College of Agriculture campus were first observed by the writers to bloom in March, 1924. Earlier blooming might have taken place, as a herbarium collection deposited in the National Museum Division, Bureau of Science, shows that

Mr. J. E. Higgins, formerly a professor of agronomy of the College of Agriculture, collected specimens of this species with mature inflorescence March 4, 1922. As far as the writers are aware this is the earliest record of the blooming of this species on the campus. Opportunities for observing the floral behavior of this species offered themselves during 1925, 1926, and 1931.

Anthesis.—March 25 and 26, 1925, and March 1 and 2, 1926, hourly observations were made on the opening of the male and perfect flowers for a period of twenty-four hours. During each observation eighty flowers of each kind were studied.

The mode of opening and separation of the perianth lobes in both flowers is perfectly identical. Long before anthesis, the perianth lobes are intact (Plate 1, fig. 7) at their margins and seem to be so well fitted together as to be nearly air-tight. This is indicated by the slight puffing action when a slight pressure is applied on the perianth. Separation of the perianth lobes usually begins at about 10.45 to 11 p. m. Small slits between the lobe margins are formed (Plate 1, fig. 1) simultaneously, usually starting at the middle where the opening is the widest. Sometimes slit formation takes place between two opposing margins of the lobes (Plate 1, fig. 2), so that the lobes become separated into one group of two lobes and another with three lobes. Between 1.07 and 1.25 a. m. the third slit is formed (Plate 1, fig. 4) separating one of the lobes from the group of three. Sometimes, a fourth slit is simultaneously formed so that three lobes become distinctly separated, while the two still remain intact (Plate 1, fig. 5). When slits are formed simultaneously between the lobes (Plate 1, fig. 1) early at night (10.45 to 11 p. m.), we obtain a condition similar to that shown in Plate 1, fig. 3, where three of the lobes remain intact only at their apices, while the other two touch each other only at their apices. These conditions remain throughout the early morning, and at about 4 to 4.15 a. m. all of the lobes separate from one another completely (Plate 1, fig. 6) and begin to curve outward very slowly until the perianth segments are actually distended and curved outward, thus exposing the sexual organs at 5 a. m. or at dawn. Anthesis is accompanied by an exhalation of a characteristic odor, which attracts insects and lasts practically the whole day. In other words, the perianth lobes begin to separate at about 11 p. m. and are completely distended at 5 a. m., a period covering practically six hours. In no case did the writers observe a single flower remaining closed; all of them (male and hermaphrodite) opened.

Movement of the pistil.—Movement is essentially confined to the stalk bearing the pistil and the stamens or the stamens and the rudimentary pistil, and to the style of the pistil in the hermaphrodite flower.

When the hermaphrodite flower has attained a diameter of about 7 to 8 millimeters, its pistil and stamens inclosed by the perianth segments (Plate 1, fig. 7) are very well differentiated and developed. Its pistil is borne on a very short, stubby, terete stalk arising from the center of the perianth. As the flower develops and enlarges, this stalk elongates (Plate 1, fig. 8) vertically, thus pushing the stigmas way down against the apices of the perianth lobes. This elongation is accompanied by an unequal growth or elongation of the cells of the stalk on one side, which results in the bending of the same stalk. This combined elongation and bending of the stalk is completed prior to 9 p. m., the night before anthesis. On the other hand, the style begins to elongate and bend early in the morning (8 a. m.), the day prior to anthesis, and continues to do so until 3 p. m. of the same day, at which time the style assumes a nearly horizontal position (Plate 1, fig. 11). Bending of the style and the stalk, therefore, must have started more than fifteen hours before anthesis when the sexual organs are fully exposed. The pistil retains this position through the night until about 4 a. m. the next day, when another active bending takes place in the style alone. This further growth of the style keeps it nearly touching the carpel wall of the ovary (Plate 1, fig. 12) and the stigmas directed towards the pedicel. The style, therefore, has two periodic movements; during and after the first movement the stigmas may be placed in such a position that a slight chance for self-pollination, or autogamy, may be attained, although, as is noted below, this seems to be improbable.

The movement of the stalk of the male flower is very similar to that described for the hermaphrodite flower. In this the elongation and curvature of this stalk is much more pronounced (Plate 1, fig. 9) so that at anthesis the anthers are placed in a nearly oblique position facing the perianth. No movement of the rudimentary pistil has been noted.

Dehiscence.—Dehiscence of the pollen grains was observed for three years (1925, 1926, and 1931) and was found to take place between 1 and 2 a. m. The anthers never dehisce their contents all at one time; they open one after another in no regular succession for a period of an hour. It is very interesting to note that dehiscence takes place at the time when the stigmas are

held nearly horizontal (Plate 1, fig. 11), so that pollination, or autogamy, even by gravity, is rather difficult, if not impossible. The direct line of fall of the pollen grains does not coincide with the position of the stigmas so that pollen grains would rarely lodge on the stigmas. Protrandry is the rule in this species as dehiscence takes place long before complete anthesis is attained.

Emasculation.—To ascertain whether the bending of the style and the stalk is influenced by the presence of the stamens at the base of the ovary in the perfect flower, one hundred hermaphrodite flowers were emasculated in March, 1926, and 1931, at 8 a. m., before the styles had a chance to show any sign of movement. For emasculation flowers that were expected to open the next morning were selected. With a slight pressure applied on the perianth, the lobes were mechanically separated from one another, and a pair of fine forceps was inserted into the perianth. The anthers were removed carefully, one by one, care being taken to dip the forceps in ethyl alcohol (95 per cent) every time a stamen was removed from a flower. Beginning at 9 o'clock that night, hourly observations were made on the behavior of the styles and stalks of the emasculated flowers; the results are interesting. The stalks bearing the pistils elongated and bent as described above, but their styles never changed their positions for twenty-four hours from 9 p. m., these remaining perpendicular to the axis of the ovary. None of the emasculated flowers produced fruits; they shriveled and dried, remaining on the floral cluster for some time until the whole inflorescence abscinded from the tree. It seems very likely that some direct relation really exists between the bending of the styles and the presence of stamens at the bases of the ovaries, but not with the elongation and bending of the stalks bearing the pistils. The presence of stamens serves perhaps as a stimulus for such movement of the style.

The writers believed that gravity might play a part in the bending of the style in this species. March 1, 1931, two large branches bearing numerous flowers or floral clusters were tied to a long wooden pole so as to change the normal position of the individual flowers. This was done at 8 a. m. The relative positions of one hundred perfect flowers were noted and recorded; some were held in an inverted position, while others were held laterally. Hourly observations were made on these flowers for a period of twenty-four hours. The young flower buds (mostly males) that did not open the next morning were decapitated, while fifteen were allowed to remain as controls.

Only five of the hermaphrodite flowers held laterally showed bending of their styles; the styles of those that were turned upside down exhibited no movement at all, but remained vertical with the stigmas directed upward as before. The young male flowers used as control were able to change their position and assumed the normal pendant position the next morning. Although the data herein presented on the influence of change of position on the movement of the styles seem insufficient, there are indications to show that gravity has little or nothing to do with the bending of the styles.

It is clearly evident that self-pollination here may be inadequate because of the nonsynchronous movements of the style and stalk with the time of dehiscence. Cross-pollination may be possible though, because of the possibility of pollen transfer by insects during the early morning when the stigmas are still receptive. In many species of angiosperms movements of the style or stigma and stamens bring about autogamy and pollination very successfully. Knuth,(2) for example, cites *Epilobium angustifolium* Linn. as having flowers with styles short at first; later, after twenty-four hours from anthesis, these elongate, and the widely divergent stigmas finally recurve so as to touch the pollen-covered anthers. In *Oenothera biennis* Linn. the style straightens half an hour after anthesis, and the stigmas spread out, so that crossing may be effected by insects already dusted with pollen. As the four stigmas roll back they ultimately touch the anthers before these have lost their pollen. In *Stachys sylvatica*(3) the style, at first with almost apposed branches, is situated behind the anthers, which have dehisced downward. Later the style bends downward under the anthers and, at the same time, opens its branches widely. If insects fail to visit the flower, autogamy is effected by the stigmatic branches, which slide gradually between the anthers that are still covered with pollen, or the stigmatic branches bend downward until they touch the anthers. Similar movements of the styles in *Valerianella olitoria* Pollich., *Morina elegans* Fisch. and Avé-Lall., and *Tricyrtis pilosa* Wall. also effect autogamy.

Hildebrand(1) observed that the movement of the floral organs in *Cleome spinosa* and *C. gigantea* was due to gravitation. He further states that as the position of the floral organs in this respect is altered, the stigmas and the anthers always assume such positions that they do not come in contact with one another, and cross-pollination is promoted.

Knuth(3) also mentions that the movements of the stamens of *Berberis vulgaris* Linn. are caused by the flow of water in the stimulated part. The stamens bend inward towards the stigma due to the presence of a special tissue, consisting of elongated narrow cells which are almost fused together and provided with small intercellular spaces, especially at their ends. The transverse walls of these cells are thin, and their longitudinal walls, on the contrary, are thick with numerous scattered pits which render possible both a very rapid interchange between cells and also a quick bending of this elastic tissue. On stimulation, the stamen becomes lax, spreads out, curves like a bow, while its edges pull upon the transverse walls, and its convex central part presses against the outer wall, which becomes strongly arched. Hence, the cells become shorter and thicker. This change in the motile tissue causes the filaments to bend inward.

Artificial pollination.—In March, 1926, artificial pollination of one hundred hermaphrodite flowers was performed by the writers. The pollen was collected between 1 and 2 a. m. from normal male flowers with the use of a camel's hair brush. The pollen grains were gently brushed against the stigmas of the perfect flowers that were to open that same morning. This was repeated in March, 1931. Of the one hundred flowers thus artificially pollinated, only two developed fruits in 1926, and only one in 1931. These results clearly indicate two possibilities; namely, that the nonsetting of fruits may be due to lack of proper pollination or to the presence of defective pollen, defective ovular contents, or similar conditions inherent in the plant. The writers have no information to offer on this matter.

Insect visitors.—As fruit setting is rather rare, it seemed in order to find out what kind of insects usually visit the flowers. March 1, 1926, several insects were observed flying from flower to flower. Some of the insects that were found between 8 to 10 a. m. were *Erassa penangæ* Moore (a moth), *Trigona biroi* Fabr., *Monolepta bifasciata* Hornst. (a beetle), and *Cantharis granulipennis* Blanchard (a beetle).[3] During the afternoon, from 3 to 5 p. m., the following insects were the frequent visitors: *Erassa penangæ* Moore, *Trigona biroi* Fabr., and *Lucilia dux* Linn. (a fly). In the evening only moths and flies visited

[3] The identification of these insects was made by Dr. Leopoldo B. Uichanco, of the College of Agriculture, to whom the writers are greatly indebted.

the flowers, and their activities seemed to stop after 8 p. m. Throughout the whole night practically no other insects visited the flowers.

March 10, 1931, another observation on insect visitors was made by the writers. The day was bright and clear, and the plant was in full bloom. The insects observed are listed in Table 1.

TABLE 1.—*Insects that visited flowers of Sterculia apetala March 10, 1931, from 7 a. m. to 12 noon and from noon to 4.15 p. m.*

	7 a.m. to 12 noon.	12 noon to 4.15 p. m.
Apis indica Fabr., race *nigrocincta* Smith (Apidæ, Hymenoptera)	−	+
Chalcididæ, Hymenoptera (parasitic wasp)	+	+
Cantharis flavifemoralis Blanchard (Coleoptera)	+	−
Chilomenes 6-maculata Fabr. (Coccinelidæ, Coleoptera)	+	+
Chalcididæ, Hymenoptera (wasp)	+	+
Ceratia similis Oliver (Chrysomelidæ, Coleoptera)	−	+
Dasyproctus philippinensis Ashmead (Crabronidæ, Hymenoptera)	+	−
Diacamma sp. (Formicidæ, Hymenoptera)	+	−
Dysdercus megalopygus Breddin (Pyrrhocoridæ, Hemiptera)	+	−
Dysdercus pœcilus H. S. (Pyrrhocoridæ, Hemiptera)	+	+
Mycetophilidæ, Diptera	+	−
Muscoidea, Diptera	+	+
Musca sp. (Muscidæ, Diptera)	−	+
Plecoptera	+	−
Polyrhachis dives Sm. (Formicidæ, Hymenoptera)	+	+
Phyllodromia sp. (Blattidæ, Orthoptera)	+	−
Odynerus hæmorrhoidalis var. *ater* Sauss. (Eumenidæ, Hymenoptera)	−	+
Reduviidæ, Hemiptera	−	+
Syrphidæ, Diptera	+	+
Tabanus striatus Fabr. (Tabanidæ, Diptera)	−	+
Tachinidæ, Diptera	+	+

At night, from 8 to 6 o'clock the next morning, no insect other than mosquitoes were observed to visit the flowers.

Of the insects enumerated above, the following are the only possible flower pollinators: *Apis indica* Fabr. race *nigrocincta* Smith., *Dasyproctus philippinensis* Ashmead, *Odynerus hæmorrhoidalis* var. *ater* Sauss., and possibly the Muscoidea (Diptera), *Musca* sp. and Syrphidæ (Diptera). These are mostly present during the early forenoon, while others may continue to visit the flowers even in the afternoon.

From the above observations it is apparent that insect visitors are rather numerous in the early morning and afternoon, and practically absent at night. As dehiscence takes place at the time when insect visitors are absent, this species is dependent largely, if not entirely, on autogamy for pollination. During the day when insects are numerous, the anthers are wholly, if not entirely, devoid of their contents, as their pollen grains have been dehisced by them. Of course, during the early morning hours when the stigmas are still receptive, a certain amount of cross-pollination may occur.

SUMMARY

Macroscopical observations on the floral behavior of *Sterculia apetala* (Jacq.) Karsten (*Sterculia carthaginensis* Cav.) are herein reported. The flowers (hermaphrodite and male) start to open at about 11 p. m. and are completely opened by 5 o'clock the next morning. Simultaneous elongation and bending of the stalk bearing the pistils and stamens as well as stamens alone have been noted. These movements may bring the stigma in the line of fall of the pollen grains, but since anthesis takes place at the time the stigmas have already passed this line, autogamy hardly occurs.

Insects visiting the flowers are abundant during the day and are practically absent at night, during which time anthesis takes place. Scarcity of fruits that are set during each blooming period may be attributed to the poor device for bringing about self-pollination in this species.

The presence of stamens on the ovary is believed to be the stimulus necessary for the movement of the style but not the stalk bearing the pistil. Gravity has very little, if any, influence on the movements of the style and stalk bearing the pistil.

Artificial pollinations disclosed the fact that the nonsetting of fruits may be due either to the lack of proper pollination or to the presence of defective pollen, defective ovular contents, and the like.

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4. Standley, P. C. Trees and shrubs of Mexico. U. S. Nat. Museum Contrib. 23[3] (1923) 517–848.

ILLUSTRATIONS

[The drawings were retraced by Mr. V. V. Marasigan, of the National Museum, Bureau of Science, from the original drawings of the senior author. The photographs were taken by the photographic division of the College of Agriculture.]

PLATE 1. STERCULIA APETALA (JACQ.) KARSTEN

FIG. 1. Front view of the hermaphrodite flower showing early formation of slits between the perianth lobes, collected at 10.45 p. m.; × 1.
2. The same as fig. 1, collected at 10.50 p. m.; × 1.
3. The same, collected at 1 a. m.; × 1.
4. The same, collected at 1.25 a. m.; × 1.
5. The same, collected at 1.30 a. m.; × 1.
6. Another flower showing all its lobes fully separated from one another, collected at 4 a. m.; × 1.
7. Young hermaphrodite flower with portion of its perianth removed to show the short stalk bearing the pistil, the ovary of which bears at its base the stamens; × 3.
8. Showing elongation of the stalk bearing the pistil and stamens in hermaphrodite flower; *pe*, perianth; × 3.
9. A mature male flower with a portion of its perianth, *pe*, removed to show the long, curved stalk bearing the anthers at its apex (rudimentary pistil not seen); × 3.
10. Showing the bending of the stalk bearing the pistil and stamens in the hermaphrodite flower; × 3.
11. Showing the anthers already dehiscing, while the style is held horizontally; *ov*, ovary; × 3.
12. At anthesis, showing the style, *se*, completely bent and the stalk fully bent and elongated; *pl*, pedicel; *sa*, stigmas. Note the wide dehiscence of the anthers, *st*; × 3.

PLATE 2. STERCULIA APETALA (JACQ.) KARSTEN

The plant in full foliage and in full bloom. Photographed March 17, 1926.

PLATE 3. STERCULIA APETALA (JACQ.) KARSTEN

The same tree nearly defoliated. Shows active growth of new leaf buds at the axils of which are formed the inflorescence initials at nearly the same time. A few old dry leaves still persist on the terminal branches. Photographed February 9, 1931. This tree was uprooted by a typhoon in 1935.

PLATE 4. STERCULIA APETALA (JACQ.) KARSTEN

Another tree of the same species growing near the administration building (north side) in full bloom and in full foliage. Abundant dried leaves on the ground. On the right is a stem of a young royal palm, and *Phytolaca dioica* Linn. on its extreme right. *Averrhoa bilimbi* Linn. is in the background between the *Sterculia* and the royal palm. Photographed March 30, 1926.

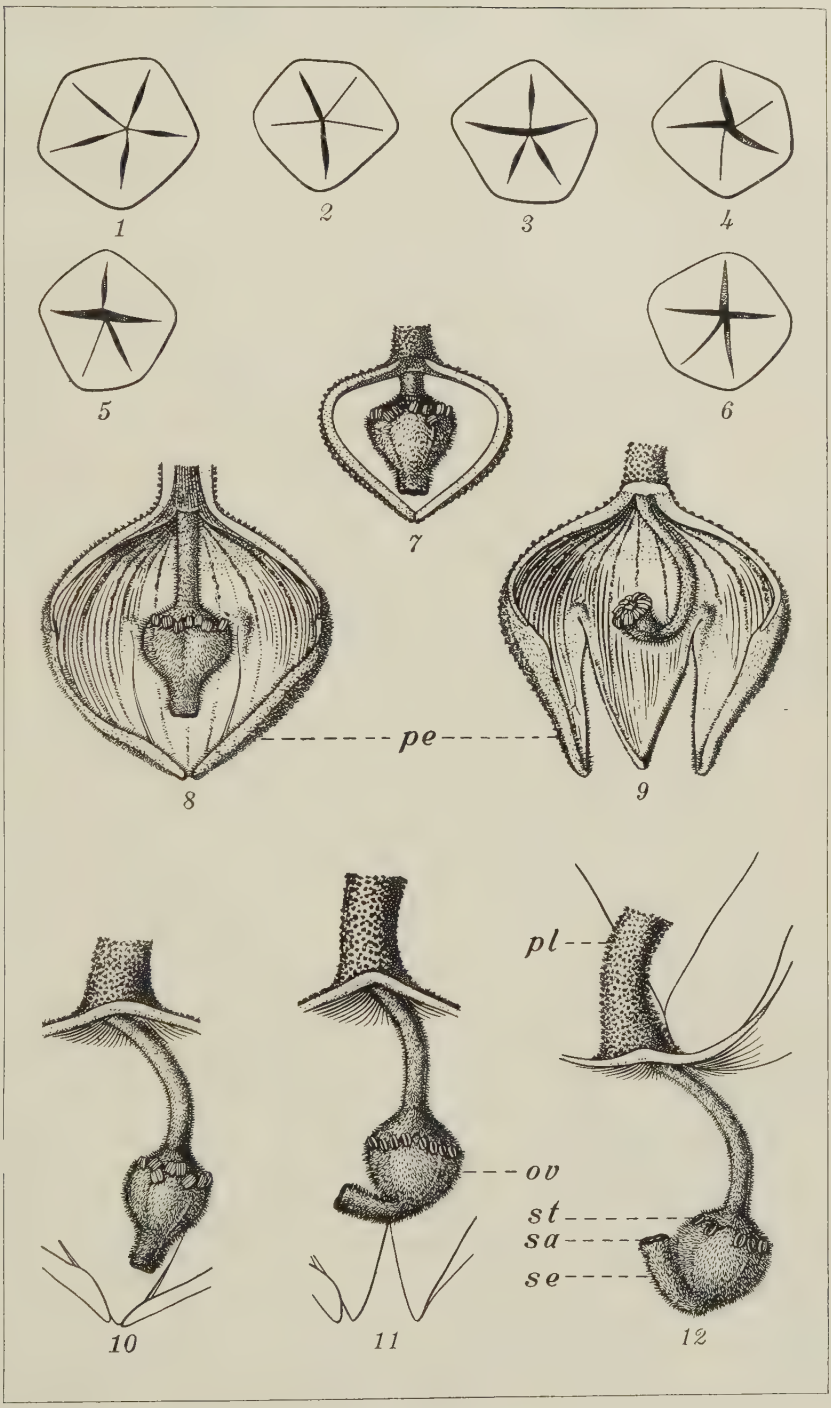

PLATE 1.

PLATE 2.

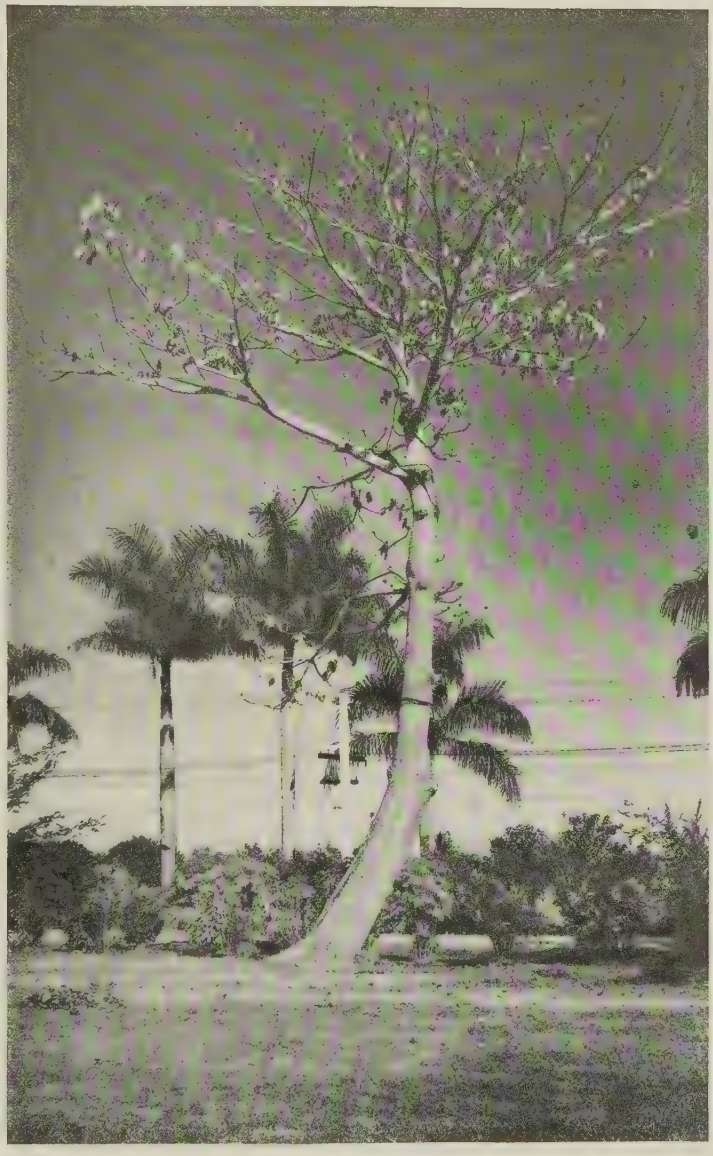

PLATE 3.

PLATE 4.

PHILIPPINE RUSTS IN THE CLEMENS COLLECTION 1923–1926, II[1]

By J. C. Arthur and George B. Cummins

Of the Department of Botany, Purdue University Agricultural Experiment Station, Lafayette, Indiana

FOUR PLATES

ON MORACEÆ

52. CEROTELIUM ALLAEANTHI Syd.

On *Allaeanthus luzonicus* (Blco.) F. Vill. var. *glaber* (Warb.) Merr., Luzon, Isabela Province, Cabagan, January 16, 1924, *Clemens 1697.*

53. CROSSOPSORA FICI sp. nov. Plate 2, fig. 3.

Uredíis hypophyllis, subepidermalibus, minutis, brunneis, paraphysibus periphericis, hyphoideis; urediosporis irregularis, ellipsoideis, obovoideis vel triangularis, 16–19 x 19–30 μ; membrana 1.5 μ cr., cinnamomea, echinulata, poris germ. 3, aequatorialibus. Teliis hypophyllis, filiformis, brunneis, 2–5 mm longis; teliosporis oblongis, 7–10 x 23–30 μ; membrana 1 μ cr., pallide brunnea.

On *Ficus variegatus* Bl., Luzon, Zambales Province, Castillejos to Subic, March, 1924, *Clemens 1727.*

54. PHYSOPELLA FICI (Cast.) Arth.

On *Ficus Cumingii* Miq., Luzon, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5123.* On *Ficus hauili* Blco., Luzon, Bulacan Province, Sibul Springs, December, 1924, *Clemens 4947;* Benguet Subprovince, Adouay, February 24, 1925, *Clemens 5021;* Baguio highway, February, 1925, *Clemens 5812.* On *Ficus religiosa* L., Luzon, Manila, February 5, 1924, *Clemens s. n.* On *Ficus subulata* Bl., Mindanao, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2031.* On *Ficus* sp., Luzon, Isabela Province, Ilagan, December 24, 1924, *Clemens 1812.* Cebu, Cebu, May 16, 1924, *Clemens 4921.* On *Malaisia scandens* (Lour.) Planch., Luzon, Isabela Province, Echague, December 19, 1923, *Clemens 1735.*

[1] Contribution from the Department of Botany, Purdue University Agricultural Experiment Station, Lafayette, Indiana.

55. UREDO ARTOCARPI B. and Br.

On *Artocarpus communis* Forst., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 1979.*

ON URTICACEÆ

56. PUCCINIASTRUM PIPTURI Syd.

On *Pipturus arborescens* (Link) C. B. Rob., LUZON, Cagayan Province, Callao Caves, January 14, 1924, *Clemens 1721:* Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5166.* On *Pipturus repandus* Wedd., LUZON, Nueva Vizcaya Province, south of Santa Fe, January 25, 1924, *Clemens 1691.*

It is doubtful whether this species can belong in the genus *Pucciniastrum.* The uredia have hyphoid, hyaline, peripheral paraphyses surmounting a very short and indistinct peridium. Such characters would indicate a relationship with *Cerotelium* rather than *Pucciniastrum.* In the absence of telia there can be no advantage in shifting the species about, however.

57. PUCCINIASTRUM BOEHMERIAE (Diet.) Syd.

On *Boehmeria multiflora* C. B. Rob., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5810.* On *Cypholophus brunneolus* Elm., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5809.*

58. UREDO sp.

On Urticaceæ (*Pilea?*), LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 4986.*

Apparently this rust has not been described, but because of the uncertainty regarding the identity of the host and the fragmentary character of the specimen we are listing it as above. The uredia are amphigenous, erumpent, cinnamon-brown, with a few peripheral, brownish, thin-walled paraphyses; urediospores ellipsoid or globoid, 18 to 23 by 24 to 29 μ; wall 2 to 3 μ thick, cinnamon-brown, sharply echinulate, pores 2 and equatorial. The rust is probably a species of *Puccinia.*

ON POLYGONACEÆ

59. PUCCINIA CONGESTA B. and Br.

On *Polygonum chinense* L., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5012.* On *Polygonum tomentosum* Willd., LUZON, Tarlac Province, Gerona, January, 1925, *Clemens 4951.*

60. PUCCINIA POLYGONI-AMPHIBII Pers.

On *Polygonum chinense* L., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5125;* Baguio, February, 1925, *Clemens 5819, 5819a.*

Only uredia are represented in these collections. The spores have two or three pores near the hilum, as in the North American form on *Polygonum virginianum.*

ON ANONACEÆ

61. AECIDIUM UVARIAE-RUFAE P. Henn.

On *Uvaria rufa* Bl., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4856.*

ON AMARANTHACEÆ

62. UROMYCES DEERINGIAE Syd.

On *Deeringia baccata* (Retz.) Moq., LUZON, Benguet Subprovince, Mount Pulog, below Camp 42, February 24, 1925, *Clemens 5030.*

ON RANUNCULACEÆ

63. COLEOSPORIUM CLEMATIDIS Barcl.

On *Clematis gouriana* Roxb., LUZON, Benguet Subprovince, between Camp 42 and Adouay, February 27, 1925, *Clemens 4988.*

64. PUCCINIA EXHAUSTA Diet.

On *Clematis gouriana* Roxb., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 2002.* LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5814.*

ON BERBERIDACEÆ

65. PUCCINIOSIRA CLEMENSIAE sp. nov. Plate 2, fig. 2.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, in greges maculis laxe dispositis, albido-flavis; cellulis peridii irregularis, oblongis, verrucosis, laxi conjunctis; teliosporis oblongis, 14–19 x 26–32 μ, utrinque rotundatis, medio leviter constrictis, levibus, facillime in loculos secedentibus, episporio 1–2 μ cr.; cellulis intercalaribus conspicuis.

On *Berberis barandana* Vid., LUZON, Benguet Subprovince, Mount Pulog, February 25 to 26, 1925, *Clemens 4974.*

We take great pleasure in naming this species in honor of Mrs. Clemens, whose botanical work in the Philippine Islands has resulted in many important discoveries.

ON LAURACEÆ

66. AECIDIUM MACHILI P. Henn.

On *Machilus philippinensis* Merr., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5815.*

ON SAXIFRAGACEÆ

67. PUCCINIOSTELE CLARKIANA (Barcl.) Diet.

On *Astilbe philippinensis* Henry, LUZON, Benguet Subprovince, near Camp 42, en route to Mount Pulog, February 24, 1925, *Clemens 5028;* Mount Santo Tomas, February 19, 1925, *Clemens 5811a.*

ON ROSACEÆ

68. HAMASPORA ACUTISSIMA Syd.

On *Rubus moluccanus* L., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2029.* On *Rubus niveus* Thunb., LUZON, Benguet Subprovince, Mount Pulog region, February 27, 1925, *Clemens 5130, 5131.* On *Rubus pyrifolius* Sm., MINDANAO, Thermal Springs, Mount Apo, May 30, 1924, *Clemens 2024.* On *Rubus Rolfei* Vid., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 5135, 5136.*

69. KUEHNEOLA JAPONICI Diet.

On *Rosa philippinensis* Merr., LUZON, Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4989.*

70. GERWASIA FASCICULATA sp. nov. Plate 2, fig. 1.

Pycniis et aeciis ignotis. Urediis epiphyllis, minutis, intraepidermalibus; urediosporis globosis vel ellipsoideis, 18–23 x 25–30 μ; membrana 2 μ crassa, hyalina, aculeata, poris germ. obscuris (3 aequatorialibus?). Teliis hypophyllis, minutis, pallidis, subepidermalibus, per stomata erumpentes; paraphysibus peripheric is, hyalinis, valde curvatis, membrana crassa; teliosporis et paraphysibus in apice hypharum erumpentium ortis, teliosporis globosis vel ellipsoideis, 19–22 x 26–34 μ; membrana 1 μ crassa, ad apice 3 μ, hyalina, levis; pedicello brevi.

On *Rubus* sp., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 5134.*

The telia of this rust are similar to those described for the genus *Gerwasia* in their mode of formation but differ in the curiously contorted nearly solid paraphyses. Because of the small size of the telia it is difficult to gain a clear conception of the base of the sorus, but it apparently originates beneath the epidermis and develops a slender stalk which passes through a stoma. Above the epidermis and at the apex of this stalk a

tangle of paraphyses is formed and among them the teliospores. Apparently the paraphyses and the teliospores are developed from the same stalk cell. The pedicels of the teliospores consist of one short cell. The uredia are formed in cavities in the hypertrophied epidermal cells.

Our attempts to obtain a specimen of *Gerwasia rubi* Racib. have proved futile. Nevertheless, we assign this new species to the genus *Gerwasia* rather than to *Mainsia* in the belief that the latter genus will prove to be synonymous with *Gerwasia*. A solution to the relationship of these peculiar rusts of *Rubus* will require a study of Raciborski's type, presumably to be found at the Botanical Institute, Jagellonian University, Krakow, Poland, or the rediscovery of the species.

71. UREDO sp.

On *Rubus Copelandi* Merr., LUZON, Benguet Subprovince, Mount Pulog, February, 1925, *Clemens 5132*. On *Rubus fraxinifolius* Poir., LUZON, Benguet Subprovince, between Adouay and Camp 42, February, 1925, *Clemens 5129;* Mount Pulog, February 24 to 27, 1925, *Clemens 5129a, 5129b;* Mount Santo Tomas, February 19, 1925, *Clemens 5825*.

Only uredia are present on these collections. The sori are subepidermal, small, yellowish, with abundant discal, incurved, thin-walled, hyaline paraphyses; urediospores ellipsoid, 13 to 17 by 17 to 22 μ, the wall 1 to 1.5 μ thick, colorless, very finely echinulate, with several scattered pores.

It has been impossible to place this *Uredo* with certainty. The uredia are much like those of *Phragmidium* or *Hamaspora*.

ON LEGUMINOSÆ

72. PUCCINIA PERIODICA Racib.

On *Derris heptaphylla* (L.) Merr., LUZON, Zambales Province, Olongapo, March, 1924, *Clemens 1729*. On *Derris polyantha* Perk., LUZON, Tarlac Province, La Paz, December 10, 1924, *Clemens 4885*.

73. UROMYCES MUCUNAE Rabh.

On *Mucuna sericophylla* Perk., LUZON, Isabela Province, ferry below Tumauini, December 25, 1923, *Clemens 1740*. On *Mucuna* sp., MINDANAO, Todaya, Mount Apo, May, 1924, *Clemens 2023;* June 15, 1924, *Clemens 2134*. On ? *Mucuna* sp., LUZON, Cagayan Province, Callao Caves, January 14, 1924, *Clemens s. n.*

74. UROMYCES ORIENTALIS Syd.

On *Indigofera trifoliata* L., LUZON, Tarlac Province, Tarlac, November, 1923, *Clemens 4889*.

75. MARAVALIA ACHROA (Syd.) comb. nov. Plate 2, fig. 5.

Uromyces achrous SYD., Ann. Myc. 5 (1907) 491.

On ? *Dalbergia* sp., LUZON, Rizal Province, Bosoboso, February 11, 1924, *Clemens 1701.*

This interesting rust is undoubtedly a representative of the genus *Maravalia* and although we have not seen Sydow's species of *Uromyces* yet we feel certain that it is the same. Only a few urediospores, measuring 11 to 15 μ in diameter, were seen. The telia are amphigenous and, on the petioles, pulvinate and nearly colorless. The teliospores are 11 to 15 by 22 to 29 μ, delicate, and have a thin, hyaline, smooth wall. There apparently is no differentiated germ pore, the apex continues to grow during germination, to produce the 4-celled basidium.

76. SPHAEROPHRAGMIUM DALBERGIAE Diet.

On *Dalbergia polyphylla* Benth., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5905.*

This collection is assigned to the above species with some question. No uredia are present but paraphyses are present in the telia and some few show the septation which characterizes the uredial paraphyses of *S. dalbergiae.* We have not had telial material available for comparison. The teliospores in this collection are 4-celled and closely sculptured with spines which are simple or have a stellate base. The apex of the spines is not forked. The species seems to be closely related, morphologically, to *S. debile* Syd.

77. SPHAEROPHRAGMIUM LUZONICUM Yates.

On *Albizzia saponaria* Blume, LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1738.*

This collection was identified by comparison with another of Mrs. Clemens's collections (*5907*) published by Sydow.[2] While we have not had Yates's material available it should be noted that he describes the urediospores as having a single pore. The above collection, as well as *5907,* has urediospores with four pores.

78. SPHAEROPHRAGMIUM CLEMENSIAE Syd.

On *Albizzia lebbekoides* (DC.) Benth., LUZON, Bulacan Province, Angat, November, 1924, *Clemens 4853.*

In addition to this collection we also have two numbers (*5904, 5904a*) on the same host but collected at Rosales, Pangasinan Province, Luzon, February 1 to 14, 1925, which differ in having

[2] Ann. Myc. 29 (1931) 160.

urediospores measuring 13 to 18 by 23 to 34 μ. This is perhaps the same form as mentioned by Sydow.[3]

It has not been possible with our material to decide what disposition should be made of these specimens of *Sphaerophragmium* on *Albizzia*. If *S. luzonicum* has 1-pored urediospores it is distinct from *S. Clemensiae*, otherwise it seems to us doubtful that two species are justified. The third form with larger 4-pored urediospores, mentioned above, appears at present to be distinct. However, in view of the existing confusion regarding specific limits in this group it is inadvisable to further complicate the situation. Clarification of the problem can only be attained by a comparison of type specimens.

79. SPHAEROPHRAGMIUM IRREGULARE sp. nov. Plate 1, fig. 5.

Uredíis hypophyllis, subepidermalibus, minutis, 0.1–0.3 mm diam.; paraphysibus peripheríicis, brunneis, 5–7 μ diam., membrana crassa; urediosporis obovoideis vel reniformis, 19–26 x 35–55 μ, membrana 1.5–2 μ cr. vel ad apice 3–5 μ, cinnamoneo-brunneis, echinulatis, poris germ. 4, aequatoríalibus. Teliis non visis; teliosporis ex cellulis 4 compositis, oblongis vel variabilis, 24–30 x 38–52 μ; membrana 1.5 μ cr., castaneo-brunnea, aculeis subhyalinis usque 6 μ longis obsitis; pedicello hyalino, sporam aequante vel breviore.

On *Strongylodon pulcher* C. B. Rob., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2032*.

Aside from inhabiting another genus of hosts this species differs markedly from any previously described in this genus in the arrangement of the cells in the teliospores, the simplicity of the spines, and the large urediospores. The urediospores are characteristic of the genus in that they are radially asymetrical, being reniform or "mitten-shaped" in one plane and obovoid in the other.

The species is further interesting in that the teliospores approach more nearly those of *Hapalophragmium* in the arrangement of the cells and the simple nature of the spines than any previously known.

80. UREDO DERRIDICOLA sp. nov. Plate 2, fig. 6.

Uredíis hypophyllis, minutis, 100–150 μ diam., brunneis; paraphysibus peripheríicis, compactiusculis, hyalinis, ubique tenue tunicatis; urediosporis reniformis vel obovoideis, 15–23 x 23–26 μ; membrana 1.5 μ cr., cinnamomea, echinulata, poris germ. 1, super-aequatoríalibus.

[3] Op. cit. 162.

On *Derris* sp., MINDANAO, Davao Province, Todaya, Mount Apo, June 16, 1924, *Clemens 1915* (type); June 18, 1924, *Clemens 2033*. LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5137*.

This species differs from other rusts on *Derris* in having urediospores with only one germ pore. The pore is located on the concave side near the apex at the widest part of the spore. The spores are radially asymetrical, obovoid with the pore in face view but "mitten-shaped" with the pore in side view.

From the peculiar shape of the spores it seems probable that the species belongs to *Sphaerophragmium* or possibly *Hapalophragmium*.

81. RAVENELIA CLEMENSAE Syd. Plate 1, fig. 1.

On *Albizzia procera* (Roxb.) Benth., MINDANAO, Cotabato Province, near Saub, June 22, 1924, *Clemens 1965*. LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5906:* Abra Province, near Bangued, February 3, 1923, *Clemens s. n.* On *Albizzia saponaria* (Lour.) Bl., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens s. n.*

82. RAVENELIA LAEVIOIDES sp. nov. Plate 1, fig. 4.

Urediis amphigenis vel caulicolis, subepidermalibus; paraphysibus clavatis, 15–20 x 40–50 μ, membrana 3–5 μ cr., aureobrunnea; urediosporis globosis vel ellipsoideis, 15–18 x 18–20 μ; membrana 1.5 μ cr., pallide flavida, echinulata, poris germ. obscuris, 10–12, sparsis. Teliis caulicolis, 2–7 mm longis, atrobrunneis; capitulis teliosporarum leviter convexis, obscure castaneo-brunneis, levibus, 60–100 μ diam., ex sporis 3–7 in omni directione compositis, sporis singulis unicellularibus; membrana 2–2.5 μ cr., ad apicem 3–5 μ; cystidiis capitulo adpressis, eodem numero quo sporis singulis; pedicello hyalino, crasso.

On *Indigofera nigrescens* Kurz, LUZON, Benguet Subprovince, below Camp 42, February 27, 1925, *Clemens 4972*.

This species is similar to *R. laevis* D. and H., but differs in the caulicolous habit of the telia, in having 1-celled teliospores, and in the smaller size of both the urediospores and the paraphyses.

83. RAVENELIA INDIGOFERAE Tranz.

On *Indigofera zollingeriana* Miq., LUZON, Benguet Subprovince, below Camp 42, February 24 to 27, 1925, *Clemens 4973*.

84. RAVENELIA VENUSTULA Syd. Plate 1, fig. 2.

On *Acacia pennata* (L.) Willd., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4854, 4854a.*

85. RAVENELIA ORNATA Syd. Plate 1, fig. 6.

On *Abrus precatorius* L., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4929.* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5910.*

86. SPUMULA CLEMENSIAE sp. nov. Plate 1, fig. 3.

Urediis amphigenis, subepidermalibus, minutis, castaneo-brunneis; paraphysibus peripheric is, clavatis, introrsum curvatis, 10–12 μ diam., membrana 3 μ cr., ad apicem 8–10 μ, castaneo-brunnea; urediosporis oblongis, 10–16 x 24–30 μ; membrana 2 μ cr., ad apicem 3–5 μ, cinnamomeo-brunnea, echinulata, poris germ. 4, aequatorialibus. Teliis amphigenis, subepidermalibus, sine paraphyses, capitulis teliosporarum ex sporis 3–5, plerumque 4, compositis; membrana 2 μ cr., ad apicem 3–4 μ, flavida vel pallide cinnamomea, levibus; cystidiis pendulis, globosis, plerumque 2, rarius 3; pedicello, hyalino, brevi.

On *Acacia philippinarum* Benth., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1737.*

This species is especially interesting because of the simplicity of the teliospore heads. These heads are usually composed of four cells with only two cysts borne on a simple pedicel. None were seen in which the number of cysts equaled the number of spores. *Spumula quadrifida* Mains is the only other species in the genus.

87. PHAKOPSORA CROTALARIAE (Diet.) Arth.

On *Crotalaria albida* Heyne, LUZON, Pangasinan Province, Lingayen, November 23, 1923, *Clemens 1860.*

88. PHAKOPSORA PACHYRHIZI Syd.

On *Pachyrrhizus erosus* (L.) Urban, Luzon, Manila, Cementerio del Norte, September 18, 1923, *Clemens s. n.*

89. PHAKOPSORA MEIBOMIAE Arth.

On *Desmodium dasylobum* Miq., MINDANAO, Davao Province, Todaya, Mount Apo, June 12, 1924, *Clemens 1974.* On *Desmodium laxiflorum* DC., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1707.*

There appears to be little justification for considering that *Uredo desmodii-pulchelli* Syd. is distinct from this species.

90. PHAKOPSORA VIGNAE (Bres.) Arth.

On *Pueraria pulcherrima* Merr., MINDANAO, Davao Province, Todaya, Mount Apo, May, 1924, *Clemens 2022.*

91. UREDO DUNBARIAE sp. nov.

Urediis hypophyllis, minutis, subepidermalibus; paraphysibus peripheric is, hyphoideis, hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 18–23 x 25–31 μ; membrana 1.5 μ cr., echinulata, pallide flavida, poris germ. obscuris (3, aequatorialibus?).

On *Dunbaria ? rotundifolia* (Lour.) Merr., LUZON, Cagayan Province, near Aparri, January 9, 1924, *Clemens 1833.*

92. UREDO SUBNIGRA sp. nov. Plate 2, fig. 4.

Urediis hypophyllis, subepidermalibus, singulis in maculis atrobrunneis; paraphysibus peripheric is, copiosissimis, hyphoideis, 4–9 μ diam., hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 16–20 x 26–32 μ; membrana 1.5–2 μ cr., echinulata, flavida, poris germ. obscuris (4, aequatorialibus?).

On *Bauhinia Cumingiana* (Benth.) F. Vill., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4928.*

The sori are deep-seated with abundant, thin-walled paraphyses directed towards a central porelike orifice. We have found no other rust on *Bauhinia* with such paraphyses.

93. UREDO TERAMNIICOLA sp. nov.

Urediis hypophyllis, subepidermalibus; paraphysibus peripheric is paucis praeditis, hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 18–22 x 26–32 μ; membrana 1.5 μ cr., minute echinulata, pallide flavida; poris germ. obscuris (aequatorialibus?)

On *Teramnus labialis* (L.f.) Spreng., LUZON, Tarlac Province, Gerona, January, 1925, *Clemens 4952:* Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4991.*

This species differs from *U. teramni* Mayor in having paraphyses and larger spores.

94. UREDO SOCOTRAE Syd.

On *Cassia occidentalis* L., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1749.*

ON SIMARUBACEÆ

95. KUEHNEOLA HARRISONIAE (Syd.) comb. nov. Plate 3, fig. 2.

Uredo harrisoniae SYD., Ann. Myc. 26 (1928) 428.

On *Harrisonia perforata* (Blco.) Merr., LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4891:* Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5911.*

Telia hypophyllous, small; teliospores produced in chains of five to ten cells, the individual spores cuboidal, 10 to 15 μ; wall colorless, 1 to 1.5 μ thick, smooth.

The characteristically irregular or lobed urediospores have been pointed out by Sydow [4] as distinctive of the species.

Confusion exists relative to the species which should be included in *Kuehneola.* Dietel [5] has included only those species which inhabit the rosaceous genera *Rubus* and *Rosa* and has placed other similar species in *Cerotelium.*[6] Although judgment can be only tentative until a thorough study has been made of the two genera, it seems to the writers that Dietel's treatment obscures relationships.

In typical species of *Cerotelium* the urediospores are unpigmented or nearly so and have ill-defined, scattered pores. The urediospores of *Kuehneola,* on the other hand, are pigmented and have a few equatorial pores. A more complete knowledge of life cycles will be necessary to a solution of the problem.

ON GUTTIFERÆ

96. UREDO CRATOXYLONIS sp. nov.

Urediis subepidermalibus, hypophyllis, minutis, brunneis; urediosporis globoideis vel ellipsoideis, 16–20 x 20–26 μ; membrana 1.5 μ cr., ad apicem 2–3 μ cr., cinnamomeo-brunnea, echinulata, poris germ. 4, aequatorialibus.

On *Cratoxylon cochinchinense* (Lour.) Bl., LUZON, Cagayan Province, near Aparri, January 9, 1924, *Clemens s. n.*

ON BURSERACEÆ

97. SKIERKA CANARII Racib.

On *Canarium luzonicum* A. Gray, LUZON, Nueva Vizcaya Province, Bambang, January, 1924, *Clemens 1720.* On *Canarium villosum?,* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5912.*

ON EUPHORBIACEÆ

98. CROSSOPSORA SAWADAE (Syd.) comb. nov. Plate 4, fig. 1.

Cronartium sawadae SYD., Ann. Myc. 12 (1914) 109.

On *Glochidion Merrillii* C. B. Rob., LUZON, Benguet Subprovince, Mount Santo Tomas, February, 1925, *Clemens 5821.* On

[4] Loc. cit.
[5] Engler and Prantl, Nat. Pfl. 6 (1928) 60.
[6] Op. cit. 56.

Glochidion sp., LUZON, Zambales Province, Olongapo, March, 1924, *Clemens 1730.*

Pycnia and aecia are present on both collections and telia also on *1730.* The telia may arise alone or from old aecial infections. A description of the pycnia and aecia follows.

Pycnia epiphyllous, subcuticular, crustlike. Aecia mainly hypophyllous, on hypertrophied spots 3 to 10 mm in diameter, located deep within the tissue of the host, without peridium, opening irregularly; aeciospores ellipsoid or oval, often narrowed above, 15 to 21 by 24 to 30 μ; wall 1.5 μ thick or slightly thicker above, colorless, echinulate, pores obscure but seemingly equatorial.

We transfer this species to *Crossopsora* in the belief that its relationship is with that genus rather than with *Cronartium.* Aecia have not previously been reported for the genus and this species is unique in lacking uredia. The echinulate aeciospores are distinctive and decidedly different from the known aeciospores of *Cronartium.*

99. CROSSOPSORA ANTIDESMAE-DIOICAE (Rac.) comb. nov.

Uredo antidesmae-dioicae RAC., Paras. Algen und Pilze Javas 2 (1900) 33.

Cronartium antidesmae-dioicae SYD., Ann. Myc. 14 (1916) 259.

On *Antidesma ghesaembella* Gaertn., LUZON, June 1923, *Clemens s. n.:* Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5916a.*

The peripheral paraphyses present in the uredia in this species are typical of those found in other species of the genus. The urediospores are also pigmented and the pores indistinct but apparently equatorial.

100. PHAKOPSORA PHYLLANTHI Diet.

On *Phyllanthus benguetensis* C. B. Rob., LUZON, Benguet Subprovince, Baguio, February, 1925, *Clemens 5823.* On *Phyllanthus niruri* L., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 1746:* Bulacan Province, Santa Maria, November, 1924, *Clemens 4868.*

101. BUBAKIA BRIDELIAE (Koord.) Diet.

On *Bridelia glabrifolia* (Muell.-Arg.) Merr., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5915, 5915a.*

102. BUBAKIA GLOCHIDII (Syd.) Diet.

On *Glochidion psidioides* C. B. Rob., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1711.* On *Glo-*

chidion sp., LUZON, Cagayan Province, near Callao Caves, December 31, 1923, *Clemens 1745.*

103. RAVENELIA BREYNIAE Syd.

On *Breynia rhamnoides* (Retz.) Muell.-Arg., LUZON, Rizal Province, Bosoboso, February 11, 1924, *Clemens 1701a:* Bulacan Province, Santa Maria, November, 1924, *Clemens 4862:* Tarlac Province, Gerona, January, 1925, *Clemens 4953.*

104. MASSEEELLA FLUEGGEAE Syd. Plate 4, figs. 2 and 3.

On *Flüggea virosa* (Roxb.) Baill., LUZON, Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4992, 5027.*

As published by Sydow[7] the teliospores of this species are smooth. Careful study, however, proves that they are finely and longitudinally striate (see Plate 4, fig. 2).

105. ENDOPHYLLUM EMASCULATUM sp. nov.

Pycniis nullis. Teliis aecidioideis, hypophyllis, gregariis, maculis orbicularibus usque 4 mm diam. insidentia; cellulis peridii laxi conjunctis, oblongis vel cuboideis, 12–15 x 15–20 μ, pariete exteriore 3–5 μ cr., leve, interiore 2 μ cr., verrucoso; teliosporis unicellularis, globosis, 13–15 x 15–18 μ; episporio 1.5 μ cr., hyalino, minute verruculoso sed apparenter levibus.

On *Breynia rhamnoides* (Retz.) Muell.-Arg., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4916.*

The absence of pycnia and the smooth or perhaps minutely verrucose spores characterize this species, which seems closely related to *Aecidium alchorneae* Sacc. We have not seen germinating spores and therefore the assignment of the species to *Endophyllum* can be only tentative.

ON ANACARDIACEÆ

106. CEROTELIUM ALIENNUM (Syd. and Butl.) Arth.

On *Spondias pinnata* (L.) Kurz., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens s. n.*

ON CORIARIACEÆ

107. PUCCINIASTRUM CORIARIAE Diet.

On *Coriaria intermedia* Mats., LUZON, Benguet Subprovince, Baguio, Mount Santo Tomas, February 19, 1925, *Clemens 4968;* Mount Pulog, below Camp 42, February 24, 1925, *Clemens 5031.*

[7] Ann. Myc. 26 (1928) 424.

ON CELASTRACEÆ

108. UREDO CELASTRI sp. nov.

Urediis hypophyllis vel rarius amphigenis, subepidermalibus, brunneis; urediosporis obovoideis vel ellipsoideis, 22–27 x 28–34 μ; membrana 1.5–2.5 μ cr., cinnamomeo-brunnea, valde echinulata; poris germ. 5–7, sparsis.

On *Celastrus paniculatus* Willd., LUZON, Nueva Vizcaya Province, Bambang, January 21 to 23, 1924, *Clemens 1693*.

ON HIPPOCRATACEÆ

109. CAEOMA DIVINUM Syd.

On *Salacia philippinensis* Merr., LUZON, Tarlac Province, La Paz, December, 1924, *Clemens 4894*. On *Salacia prinoides* DC., LUZON, Zambales Province, Iba, February 27, 1924, *Clemens 1723*.

ON BALSAMINACEÆ

110. PUCCINIA ARGENTATA (Schultz) Wint.

On *Impatiens Barnesii* Hk. f., LUZON, Benguet Subprovince, Camps 30 to 42, February, 1925, *Clemens 5141*. On *Impatiens Burkei* Hk. f., MINDANAO, Todaya, Mount Apo, May 27, 1924, *Clemens 1981*.

ON SABIACEÆ

111. PHAKOPSORA MELIOSMAE Kusano.

On *Meliosma multiflora* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 1925, *Clemens s. n.*

ON RHAMNACEÆ

112. PUCCINIA GOUANIAE-TILIAEFOLIAE Syd.

On *Gouania tiliaefolia* Lam., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4857*.

ON VITACEÆ

113. PHYSOPELLA VITIS (Thüm.) Arth.

On *Cissus simplex* Blco., LUZON, Pangasinan Province, Mount Bulangao, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5917*.

114. PHAKOPSORA AMPELOPSIDIS Diet. and Syd.

On *Ampelopsis heterophylla* (Thun.) Zieb. and Zucc., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.*

ON MALVACEÆ

115. CEROTELIUM DESMIUM (B. and Br.) Arth.

On *Gossypium ? brasiliensis*, MINDANAO, Davao Province, Todaya, Mount Apo, May, 1924, *Clemens 5648*.

ON TILIACEÆ

116. RAVENELIA ATRIDIS Syd.

On *Grewia eriocarpa* Juss., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.* On *Grewia multiflora* Juss., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 4415.*

117. UREDO COLUMBIAE sp. nov. Plate 3, fig. 5.

Uredíis hypophyllis, subepidermalibus; paraphysibus periphericis, 5–8 μ diam., ad apicem attenuatis, membrana 1 μ cr., hyalina; urediosporis ellipsoideis, 16–20 x 22–29 μ; membrana 1–1.5 μ cr., pallide flavida vel hyalina, minute echinulata, poris germ. obscuris.

On *Columbia serratifolia* (Cav.) DC., LUZON, Tarlac Province, La Paz, December 10, 1924, *Clemens 4892.*

The sori in this species are rather deep-seated and in gross appearance are much like those of *Uredo lueheae* Speg., but differ in having pointed paraphyses and smaller spores.

ON ERICACEÆ

118. CHRYSOMYXA DIETELII Syd.

On *Rhododendron subsessile* Rendle, LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 4966, 4968;* Mount Pulog, February 25, 1925, *Clemens 5022.*

ON OLEACEÆ

119. UROMYCES HOBSONI Vize.

On *Jasminum aculeatum* (Blco.) Walp., LUZON, Benguet Subprovince, Adouay, February 24 to 27, 1925, *Clemens 4997, 5023a.* On *Jasminum populifolium* Blume, LUZON, Benguet Subprovince, Adouay, February 27, 1925, *Clemens 5023.*

ON THYMELEACEÆ

120. MELAMPSORA YOSHINAGAI P. Henn.

On *Wikstroemia ovata* Mey., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 2065:* LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4897.* (See also *Phaleria* under 121, next following.)

ON APOCYNACEÆ

121. ACROTELIUM ICHNOCARPI Syd. Plate 3, fig. 1.

On *Ichnocarpus ovalifolius* A. DC., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 1828;* Tarlac Province, Paniqui, January, 1925, *Clemens 4963.* MINDANAO, Davao Province, Mount Apo, Todaya, June 18, 1924, *Clemens 2058;* May 26,

1924, *Clemens 2059.* On *Phaleria* sp. (Thymeleaceæ) LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5020.* On *Trachelospermum Vanoverberghii* Merr., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens 1708.* On ? *Gymnema* sp. (Asclepiadaceæ), LUZON, Isabela Province, Echague, December 20, 1923, *Clemens 1733.*

The hosts are listed here as they appear on the labels, but it is not improbable that all are *Ichnocarpus.* There is no cause for questioning the identity of the rust, whether or not the hosts are all of a single genus.

Superficially the telia of this genus are strikingly like those of *Maravalia,* but the manner of germination by an internal basidium distinguishes the genus sharply from *Maravalia.* Except for the absence of a gelatinous matrix the telia also resemble somewhat those of the genus *Goplana,* which likewise develops an internal basidium. Urediospores may occur in individual sori or intermingled with the teliospores.

The genus is interesting but certainly has no relationship with *Coleosporium,* although Sydow [8] named it as a genus of the Coleosporiaceæ. The development of an internal basidium has evidently occurred at several widely separated places in the order Uredinales and can no longer be given major importance as a family characteristic.

122. CROSSOPSORA AGANOSMAE Syd.

On *Aganosma velutina* A. DC., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.*

123. HEMILEIA WRIGHTIAE Rac.

On *Wrightia laniti* (Blco.) Merr., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4917;* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5920.*

124. PUCCINIA ENGLERIANA P. Henn.

On *Tabernaemontana pandacaqui* Poir., LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4898;* Paniqui, January 1925, *Clemens 4962;* Gerona, January, 1925, *Clemens 4962a.* On *Tabernaemontana* sp., LUZON, Pangasinan Province, Mount Balungao, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5918.*

Aecia are present in *4898* and *4962* and probably represent the aecial stage of this species. A description follows.

[8] Ann. Myc. 26 (1928) 425.

Pycnia not seen, perhaps not formed. Aecia amphigenous and caulicolous, causing extensive hypertrophy and distortion, deep-seated, large, orange-yellow when fresh, with no peridium but with a dense layer of hyphæ and collapsed host-tissue; aeciospores globoid, ellipsoid or oblong, 21 to 27 by 28 to 40 μ; wall 3 to 5 μ thick, hyaline or pale yellowish, closely and coarsely verrucose.

125. AECIDIUM LAGUNENSE Syd.

On *Tabernaemontana* sp., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens s. n.*

This collection is fragmentary, but the rust is apparently this species, judging from the apical thickening of the walls of the aeciospores.

ON GENTIANACEÆ

126. COLEOSPORIUM EXACI Syd.

On *Exacum chironioides* Griseb., LUZON, Cagayan Province, Tuguegarao, January 14, 1924, *Clemens s. n.*

ON CONVOLVULACEÆ

127. AECIDIUM KAERNBACHII P. Henn.

On *Ipomoea* sp., MINDANAO, Davao Province, Daron, June 21, 1924, *Clemens 2061.* On *Lepistemon obscurum* (Blco.) Merr., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1820.* On *Merremia umbellata* Hall. f., MINDANAO, Davao Province, Daron, May, 1924, *Clemens 4931.* On *Merremia* sp. (or *Ipomoea* sp.), LUZON, Manila, September, 1923, *Clemens s. n.*

ON VERBENACEÆ

128. PUCCINIA EREBIA Syd.

On *Clerodendron minahassae* T. and B., LUZON, Manila, near San Francisco Church, October 9, 1923, *Clemens 1603.*

129. PUCCINIASTRUM CLEMENSIAE sp. nov. Plate 3, fig. 6.

Urediis hypophyllis, minutis; cellulis peridii cuboideis, membrana 3 μ cr., hyalina; urediosporis ellipsoideis, 13–16 x 18–21 μ; membrana 1–1.5 μ cr., hyalina, minute echinulata, poris germ. obscuris. Teliis ignotis.

On *Vitex negundo* L., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5924* (type), *5925;* Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1709.*

This species is dedicated to Mrs. Mary Strong Clemens, a discriminating collector, whose name cannot be too often associated with the Uredinales of the Philippine Islands.

130. CROSSOPSORA PREMNAE (Petch) Syd.

On *Premna nauseosa* Blco., LUZON, Manila, Cementerio del Norte, October 9, 1923, *Clemens 1604*. On *Premna* sp., LUZON, Isabela Province, Tumauini, December 25, 1923, *Clemens 1830:* Cagayan Province, Callao Caves, January 14, 1924, *Clemens s. n.*

131. UREDO CALLICARPAE Petch.

On *Callicarpa formosana* Rolfe, LUZON, Isabela to Nueva Vizcaya Province, Iligan, January 18 to 19, 1923?, *Clemens s. n.:* Tarlac Province, Gerona, January, 1925, *Clemens 4955, 4955a.* On *Callicarpa* sp., LUZON, Benguet Subprovince, below Camp 42, February 24, 1925, *Clemens 5029.*

This interesting species probably belongs in the genus *Crossopsora* near *C. premnae* which also has similar urediospores and septate paraphyses differing only in minor details.

ON LABIATEÆ

132. COLEOSPORIUM PLECTRANTHI Barcl.

On *Plectranthus diffusus* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 24, 1925, *Clemens 5142;* Mount Santo Tomas, February 19, 1925, *Clemens 5829;* Baguio, February, 1925, *Clemens 5829a.*

133. PUCCINIA PLECTRANTHELLA sp. nov. Plate 3, fig. 7.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, in maculis deformantibus profunde immersis; teliosporis oblongis vel clavatis, 14–17 x 33–50 μ; membrana 1.5 μ cr., ad apicem 2–3 μ, hyalina vel pallide flavida, levibus, statim germinantes, pedicello hyalino, brevi, fragili.

On *Plectranthus* or *Coleus* sp., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2030.*

This species is similar to *P. plectranthi* Thüm, but differs in being microcyclic and having teliospores with a much thinner apical wall and an almost total absence of color. The telia occur on small hypertrophied spots and are sunken in small pockets of the host tissue.

134. PUCCINIA HYPTIDIS (M. A. Curt.) Tr. and Earle.

On *Hyptis spicigera* Lam., MINDANAO, Davao Province, Daron, May, 1924, *Clemens 4932.*

135. PUCCINIA DILECTA Syd.

On *Gomphostema philippinarum* Benth., MINDANAO, Mount Apo, Thermal Springs, May 31, 1924, *Clemens 2028.*

ON ACANTHACEÆ

136. PUCCINIA RUELLIAE (B. and Br.) Lagerh.

On *Ruellia repens* L., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5927a.*

137. PUCCINIA THWAITESII B. and Br.

On *Justicia gendarussa* Burm. f., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4939.*

138. PUCCINIA HEMIGRAPHIDIS sp. nov. Plate 3, fig. 4.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, subepidermalibus, minutis, in macula 2–8 mm diam. insidentibus; teliosporis oblongis, medio constrictis, 18–23 x 32–50 μ; membrana 2 μ cr., ad apicem 3–5 μ, pallide castaneo-brunnea, levibus, statim germinantes; pedicello hyalino, persistenti, sporam aequante.

On *Hemigraphis* sp., MINDANAO, Mount Apo, below Todaya, May 26, 1924, *Clemens 1978.*

139. UREDO HYGROPHILAE Syd.

On *Hygrophila phlomoides* Nees, LUZON, Manila, Cementerio del Norte, February 14, 1924, *Clemens 1704.*

140. AECIDIUM THUNBERGIAE-FRAGRANTIS Syd.

On *Thunbergia fragrans* Roxb., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4918.*

141. AECIDIUM MANILENSE sp. nov.

Pycniis hypophyllis, subepidermalibus. Aeciis hypophyllis, per totam folii superficiem occupantibus; cellulis peridiis firme conjunctis, 15–18 x 28–35 μ, pariete interiore verrucoso, 4–6 μ cr., exteriore levi, 2–2.5 μ cr.; aeciosporis oblongis vel ellipsoideis, 18–26 x 24–31 μ; membrana 2–2.5 μ cr., hyalina, dense minuteque verruculosa.

On *Hygrophila phlomoides* Nees, LUZON, Manila, Cementerio del Norte, February 14, 1924, *Clemens 1597a.* On *Hygrophila* sp. (*phlomoides?*), LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5927* (type).

Pycnia do not seem always to accompany the aecia or the aecia completely displace them. Pycnia likewise occur on leaves where there are no aecia. Even in the normal appearing pycnia no pycniospores were seen.

ON RUBIACEÆ

142. COLEOSPORIUM KNOXIAE Syd.

On *Knoxia corymbosa* Willd., LUZON, Pangasinan Province, Lingayen, November, 1923, *Clemens 1800.*

143. HEMILEIA CANTHII B. and Br.

On *Plectronia pedunculariS* (Cav.) Vid., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5928.*

144. HEMILEIA VASTATRIX B. and Br.

On *Coffea arabica* L., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4938.*

145. PUCCINIA GEOPHILAE Racib.

On *Geophila herbacea* (Jacq.) Kuntze, MINDANAO, Davao Province, Mount Apo, Todaya, 1924, *Clemens 2063.*

146. UREDO PSYCHOTRIICOLA P. Henn.

On *Psychotria luzoniensis* (Cham. and Schlect.) F. Vill., LUZON, Cagayan Province, Aparri, January 9, 1924, *Clemens 1832.*

147. UREDO LASIANTHI Syd.

On *Lasianthus tashiroi* Mats., MINDANAO, Davao Province, below Mount Apo, Todaya, May, 1924, *Clemens 2017.*

148. AECIDIUM PAEDERIAE Diet.

On *Paederia foetida* L., LUZON, Cagayan Province, Callao Caves, December 31, 1923, *Clemens 1825:* Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4996.*

149. AECIDIUM FLAVIDUM B. and Br.

On *Pavetta indica* L., MINDANAO, Davao Province, Mount Apo, below Todaya, May 26 to 27, 1924, *Clemens 1975.*

150. AECIDIUM DAPSILE sp. nov.

Pycniis ramicolis vel foliicolis, subcuticularibus, lenticularis, rufo-brunneis, sine paraphysibus. Aeciis ramicolis vel foliicolis, matricem deformantibus, densiuscule dispersis, profunde immersis; cellulis peridii laxiuscule conjunctis, 10–14 x 16–24 μ, pariete exteriore levi, 2 μ cr., interiore verrucoso, 3–4 μ cr.; aeciosporis globosis, 15–18 x 17–19 μ, membrana 1–1.5 μ cr., pallide flavida vel subhyalina, minutissime verrucoso-echinulata.

On *Plectronia Mabesae* Elm., LUZON, Bulacan Province, Angat, November 3, 1924, *Clemens 4855.*

This species has much the habit of *Aecidium prolixum* Syd. on *Wrightia* and also agrees quite closely with the description of *A. hedyotidis* Syd. on *Hedyotis,* a rubiaceous genus. The

position of the pycnia is not given for the latter species. It is interesting that both *Wrightia* and *Plectronia* also serve as hosts for species of *Hemileia,* but there is no other evidence to indicate that these aecia belong in the life cycle of those species.

ON CAMPANULACEÆ

151. COLEOSPORIUM CAMPANULAE (Pers.) Lév.

On *Wahlenbergia bivalvis* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 4998.*

ON CUCURBITACEÆ

152. PUCCINIA MELOTHRIICOLA Syd.

On *Melothria mucronata* (Bl.) Cogn., LUZON, Benguet Subprovince, between Camp 30 and Baguio, February, 1925, *Clemens 5144;* Mount Santo Tomas, February 19, 1925, *Clemens 5832.*

Pycnia and uredinoid aecia are present on both specimens, in addition to uredia and telia. A description follows.

Pycnia amphigenous, subepidermal. Aecia amphigenous, subepidermal, in a small circle about the pycnia, uredinoid, cinnamon-brown; aeciospores resembling urediospores, ellipsoid or globoid, 24 to 31 by 29 to 37 μ; wall 1.5 μ thick, cinnamon-brown, sharply echinulate, pores 2, opposite and superequatorial.

ON COMPOSITÆ

153. UROMYCES BIDENTICOLA (P. Henn.) Arth.

On *Bidens pilosa* L., MINDANAO, Mount Apo, Todaya, May 30, 1924, *Clemens 2019.* LUZON, Benguet Subprovince, Adouay, February, 1925, *Clemens 5019, 5146;* Mount Santo Tomas, February 19, 1925, *Clemens 5839.*

154. UROMYCES WEDELIAE P. Henn.

On *Wedelia biflora* (L.) DC., MINDANAO, Cotabato Province, Petagos, June 22 and 23, 1924, *Clemens 1964:* Davao Province, below Todaya, June 18 to 20, 1924, *Clemens 2060.*

Only pycnia and uredinoid aecia are present on these specimens. Sydow [9] pointed out that these uredinoid aecia are the form described as *Uredo nerviseda* Syd., characterized by spores which have a single germ pore.

155. PUCCINIA MILLEFOLII Fckl.

On *Artemisia capillaris* Thunb., LUZON, Benguet Subprovince, below Adouay, February 24 to 27, 1925, *Clemens 4999.*

Uredo artemisiae-japonici Diet. is also present on this specimen.

[9] Ann. Myc. 15 (1917) 172.

156. PUCCINIA CIRSII Lasch.

On *Cirsium luzoniense* Merr., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5147, 5147a;* Mount Santo Tomas, February 19, 1925, *Clemens 5835.*

157. UREDO MICROGLOSSAE Petch.

On *Microglossa volubilis* (Wall.) DC., MINDANAO, Mount Apo, Todaya, May, 1924, *Clemens 2020.*

158. UREDO VERNONIICOLA Petch.

On *Vernonia patula* (Dry.) Merr., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens s. n.:* Rizal Province, Antipolo, February 11, 1924, *Clemens 1700.*

159. UREDO ELEPHANTOPODIS Petch.

On *Elephantopus scaber* L., LUZON, Nueva Vizcaya Province, Bambang, January 19, 1924, *Clemens s. n.*

Uredo elephantopodis and *U. vernoniicola* are probably the same species, but without telia there can be no advantage in uniting them. The septate paraphyses are similar to those found in some species of *Crossopsora,* as *C. premnae,* and it is probable that the species will be found to belong in that genus.

160. UREDO ERIGERONTIS sp. nov. Plate 3, fig. 3.

Urediis amphigenis, minutis, sparsis, subepidermalibus; urediosporis obovoideis, 15–19 x 23–33 μ; membrana 1 μ cr., pallide flavida, minute echinulata, poris germ. obscuris, 4, aequatorialibus.

On *Erigeron sumatrensis* Retz., LUZON, Nueva Vizcaya Province, Santa Fe, January 25, 1924, *Clemens 1690* (type): Benguet Subprovince, Adouay, February 24 to 27, 1925, *Clemens 5001;* Mount Pulog and vicinity, February, 1925, *Clemens 5145.*

161. AECIDIUM FORMOSANUM Syd.

On *Emilia sonchifolia* (L.) DC., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens 1705.*

162. AECIDIUM BLUMEAE P. Henn.

On *Blumea balsamifera* (L.) DC., MINDANAO, Zamboanga Province, May 20, 1924, *Clemens 4940.* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5929.*

163. AECIDIUM BANOSENSIS Syd.

On *Vernonia arborea* Ham., MINDANAO, Davao Province, Mount Apo, below Todaya, May 26, 1924, *Clemens 1977.* On *Vernonia*

vidalii Merr., LUZON, Nueva Vizcaya Province, Bambang, January 21 and 23, 1924, *Clemens 1695.*

164. PUCCINIA LACTUCAE Diet.

On *Lactuca dentata* (Thunb.) C. B. Rob., LUZON, Benguet Subprovince, above Adouay, February 24 to 27, 1925, *Clemens 5000;* Mount Santo Tomas, February 19, 1925, *Clemens 5837.*

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ILLUSTRATIONS

PLATE 1

FIG. 1. *Ravenelia Clemensiae* Syd., a teliospore head; × 650. (Bangued, Abra, February 3, 1923, *Clemens s. n.*)

2. *Ravenelia venustula* Syd., a teliospore head; × 650. (*Clemens 4854.*)
3. *Spumula Clemensiae* Arth. and Cumm., urediospores, one uredial paraphysis, and one of the teliospore heads; × 650. (*Clemens 1737.*)
4. *Ravenelia laevioides* Arth. and Cumm., one urediospore, one uredial paraphysis, and one teliospore head; × 650. (*Clemens 4972.*)
5. *Sphaerophragmium irregulare* Arth. and Cumm., one of the radially asymetrical urediospores and two teliospores; × 650. (*Clemens 2032.*)
6. *Ravenelia ornata* Syd., a teliospore head showing the characteristic sculpturing; × 650. (*Clemens 5910.*)

PLATE 2

FIG. 1. *Gerwasia fasciculata* Arth. and Cumm., a single telium showing the stalklike base with the contorted, incurved paraphyses surrounding the colorless teliospores; × about 900. (*Clemens 5134.*)

2. *Pucciniosira Clemensiae* Arth. and Cumm., two teliospores with intercalary cells. One cell is producing a basidium; × about 900. (*Clemens 4974.*)
3. *Crossopsora fici* Arth. and Cumm., two urediospores; × about 900. (*Clemens 1727.*)
4. *Uredo subnigra* Arth. and Cumm., one of the peripheral, thin-walled paraphyses and two urediospores; × about 900. (*Clemens 4928.*)
5. *Maravalia achroa* (Syd.) Arth. and Cumm., three teliospores showing manner in which the basidium is produced by a continued growth of the apex of the spores; × about 1,000. (*Clemens 1701.*)
6. *Uredo derridicola* Arth. and Cumm., two of the radially asymetrical, 1-pored urediospores; × about 1,000. (*Clemens 1915.*)

PLATE 3

FIG. 1. *Acrotelium ichnocarpi* Syd., teliospores showing the basal, proliferating cell and the manner in which the teliospores germinate by the formation of an internal basidium; × 650. (*Clemens 5020.*)

2. *Kuehneola Harrisoniae* (Syd.) Arth. and Cumm., a telium and two of the characteristically lobed urediospores; × 650. (*Clemens 5911.*)

FIG. 3. *Uredo erigerontis* Arth. and Cumm., one urediospore; × 650. (*Clemens 1690.*)

4. *Puccinia hemigraphidis* Arth. and Cumm., two teliospores; × 650. (*Clemens 1978.*)
5. *Uredo columbiae* Arth. and Cumm., one urediospore and one of the thin-walled, attenuate, peripheral paraphyses present in the uredia; × 650. (*Clemens 4822.*)
6. *Pucciniastrum Clemensiae* Arth. and Cumm., a section of a uredium showing the peridium and several urediospores; × 650. (*Clemens 5924.*)
7. *Puccinia plectranthella* Arth. and Cumm., two teliospores; × 650. (*Clemens 2030.*)

PLATE 4

FIG. 1. *Crossopsora Sawadae* (Syd.) Arth. and Cumm., a photograph showing the subcuticular pycnia and the deep-seated, aperidiate aecia; × about 100. (*Clemens 5821.*)

2. *Masseeella flueggeae* Syd., a photograph of the teliospores, showing the faint, longitudinal striations on the walls; × about 500. (*Clemens 4992.*)
3. *Masseeella flueggeae* Syd., a photograph of a portion of a telium, showing the unicellular, apedicellate teliospores and the surrounding gelatinous matrix; × about 100. (*Clemens 4992.*)

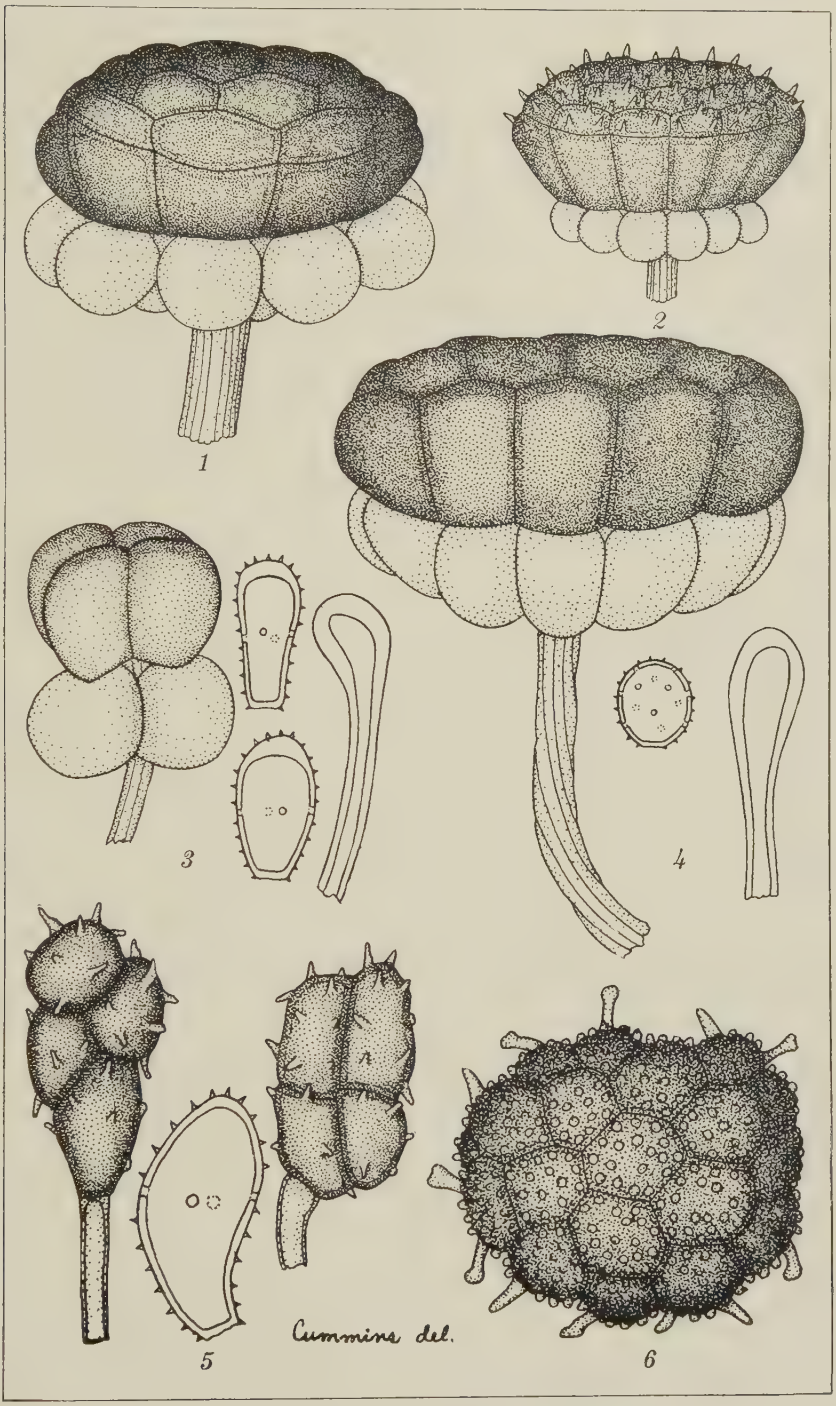

PLATE 1.

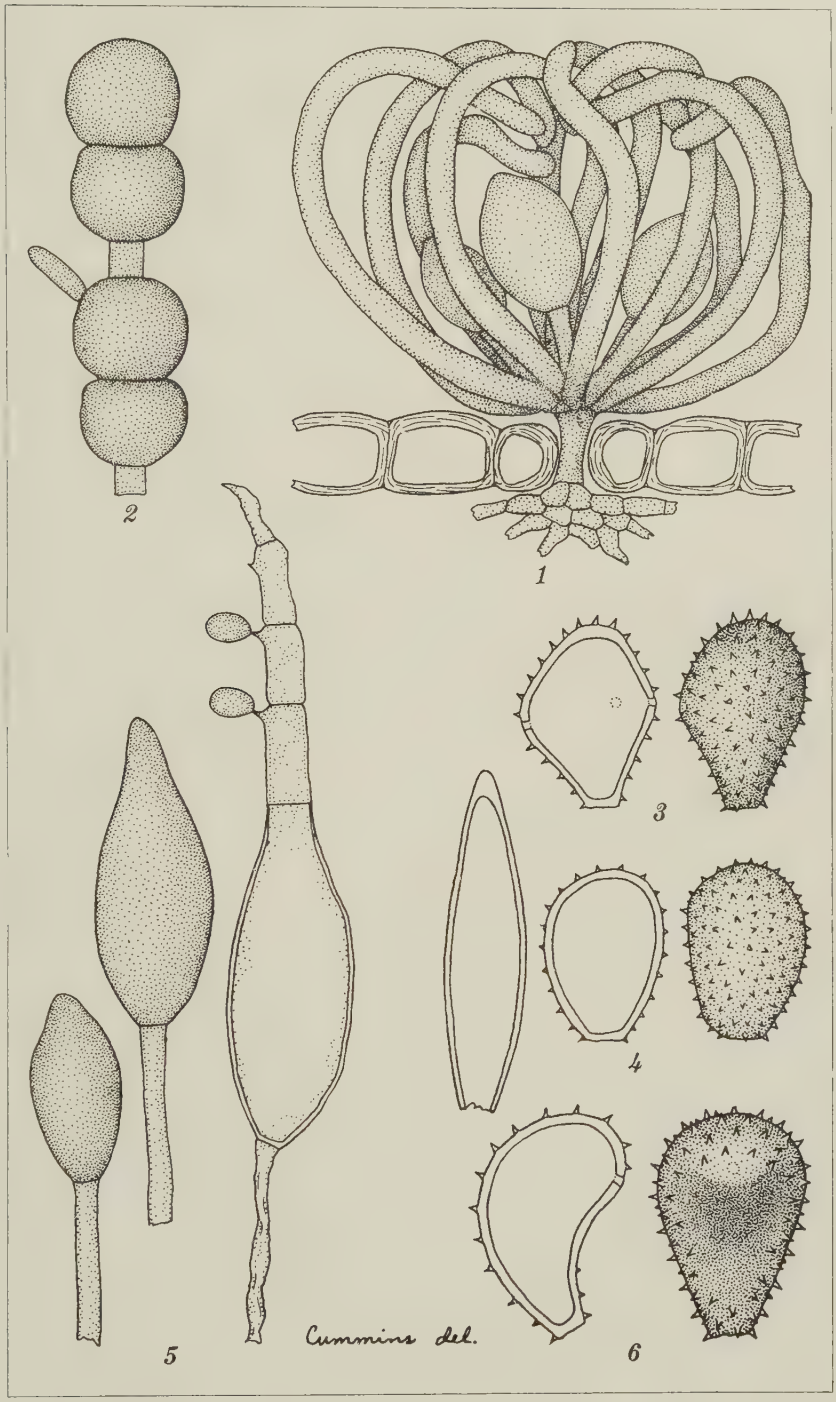

PLATE 2.

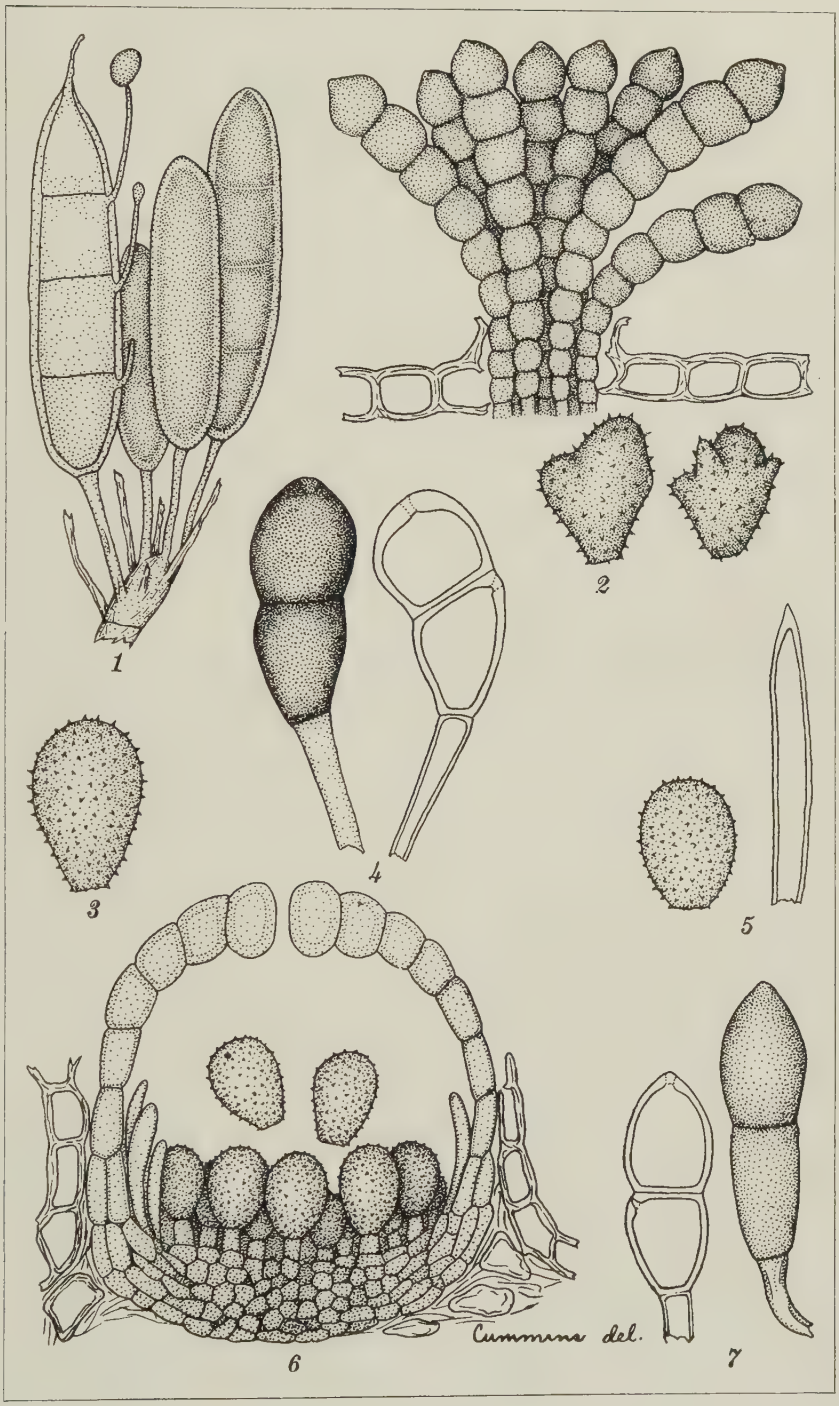

PLATE 3.

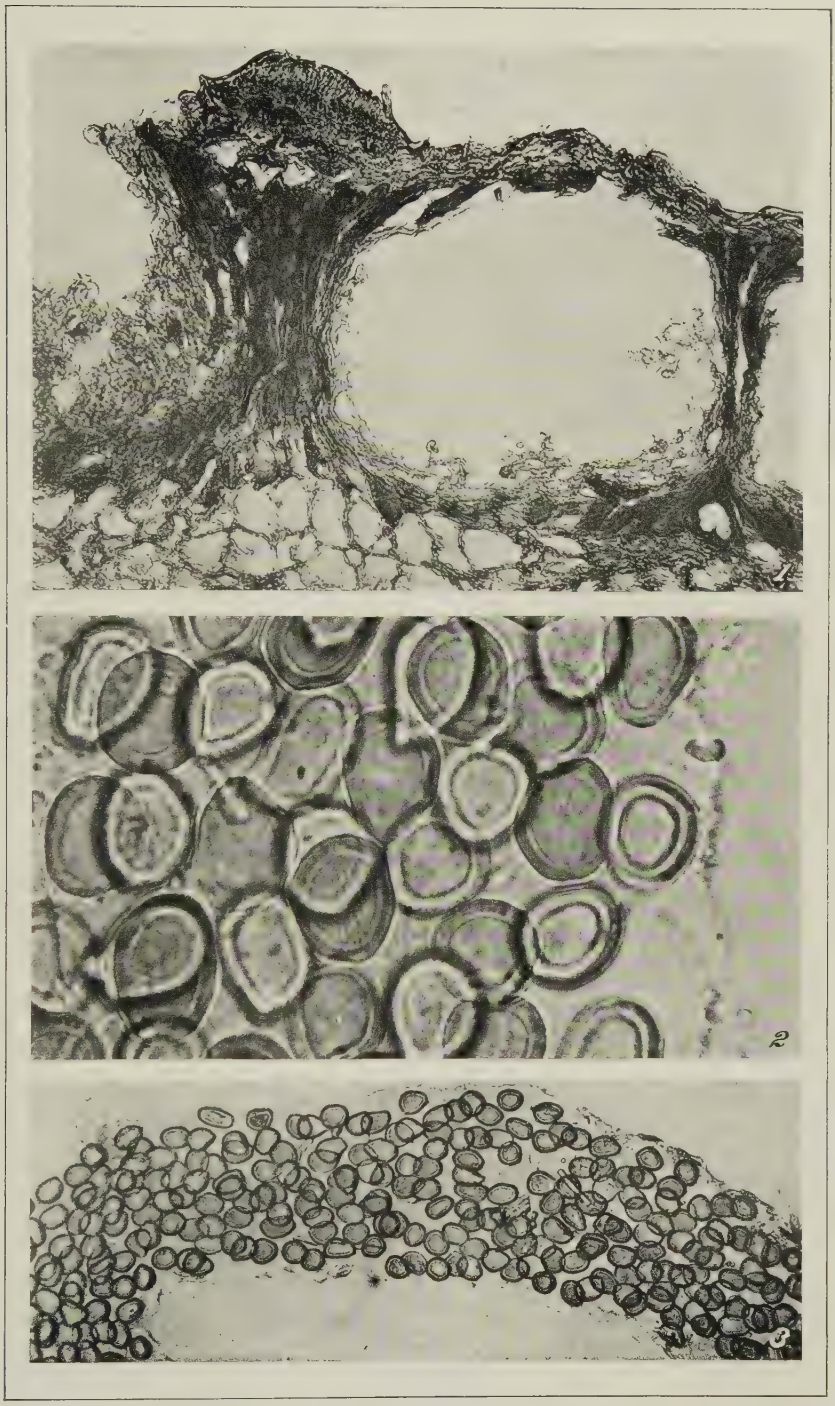

PLATE 4.

PHILIPPINE RECENT SHELLS, I

By GODOFREDO L. ALCASID

Of the National Museum Division, Bureau of Science, Manila

TWO PLATES

In the present paper all species of the family Doliidæ known or reported to occur in the Philippine Archipelago are considered.

Family DOLIIDÆ Adams

Shell thin, ventricose, ovate or subglobular, spire short, body whorl large, transversely ribbed or decussated; devoid of operculum in the adult.

Key to Philippine Doliidæ.

a^1. Shell globosely swollen, ventricose, transversely ribbed..... *Dolium.*
b^1. Shell thin, lip simple or very slightly thickened.
c^1. Interstices between ribs narrow and shallow.
d^1. Shell fulvous-brown with whitish lunate spots..... *perdix.*
d^2. Shell fulvous-chestnut, maculated with white..... *olearia.*
d^3. Shell with spiral, longitudinally lineated bands..... *cumingii.*
d^4. Shell with bands of white and brown spots..... *deshayesii.*
c^2. Interstices between ribs wide.
e^1. Shell provided with small ribs between the large principal ribs. *zonatum.*
e^2. Shell 5 banded with chestnut..... *sulcosum.*
e^3. Shell with pale brown ribs..... *allium.*
e^4. Shell with brown spots on the ribs..... *fimbriatum.*
b^2. Shell solid, lip thickened, somewhat reflected..... *poma.*
a^2. Shell elongately pyriform, ventricose, canaliculated at the base. *Pyrula.*
f^1. Shell reticulately cancellated throughout..... *reticulata.*
f^2. Shell elongated, slender, transversely ridged, cancellated. *dussumieri.*
f^3. Shell short, surface rather smooth..... *ficus.*

Genus DOLIUM Brown

Shell thin, globular, ventricose, spire short, body whorl very large, transversely ribbed, aperture large, lip simple or slightly crenulated, columella rather twisted, umbilicated.

Dolium Lamarck 1801 [1] had long been in use and generally accepted when it was found necessary to use *Tonna* Brunnich

[1] Lamarck, Anim. sans Vert. (1801) 79.

1772 [2] for priority. On further investigation it has been noted that *Dolium* Brown 1756 [3] has more claim and therefore it is being used here. Tryon used *Dolium* Linnæus,[4] and as synonyms gave *Perdix* Montfort and *Doliopsis* Conrad, but in his Manual [5] he used *Dolium* Lamarck.

DOLIUM PERDIX (Linnæus). Plate 1, fig. 1.

Buccinum perdix LINNÆUS, Syst. Nat. ed. 12 1 [2] (1767) 1197; DILLWYN, Cat. Recent Shells 2 (1817) 583.

Dolium perdix Linnæus, LAMARCK, Anim. sans Vert. 7 (1822) 261; KIENER, Icon. Coq. Viv. *Dolium* p. 4, pl. 5, fig. 9; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 6, fig. 9; HANLEY, Proc. Zool. Soc. (1859) 492; TRYON, Man. Conchol. 7 (1885) 264, pl. 3, fig. 15; pl. 4, figs. 23–25; HIDALGO, Cat. Marine Moll. (1904) 153.

Tonna perdix Linnæus, HEDLEY, Rec. Aust. Mus. 12 (1919) 335; FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell oblong-ovate, thin, spire exserted; base somewhat obliquely effused, umbilicated; whorls six, transversely ribbed, ribs about twenty, broad, smooth, rather flattened; grooves between ribs narrow and shallow; fulvous-brown marked with whitish lunate spots; interior of aperture brownish, washed with white towards the outer lip; lip simple; columella arched.

Height, 144 mm; thickness, 76; height of spire, 37; height of body whorl, 92.

Philippines, *Bur. Sci. 13205 Fulton.* BOHOL, *Bur. Sci. 14164 Kelly.* CEBU, *Bur. Sci. 14219 Lopez.* MINDORO, Calapan, *Bur. Sci. 12938 Labsan.* MARINDUQUE, *Hidalgo.* MINDANAO, Dapitan and Zamboanga, *Hidalgo.* JOLO, *Hidalgo.*

Distribution.—Coasts of America, *Linnæus;* Jamaica, *Lister;* Amboina, *Rumphius;* coast of Senegal, *Adanson;* West Indies, China, and South Seas, *Humphreys;* Indian, African, and American equatorial seas, *Lamarck;* Indian Ocean, Mauritius, Polynesia, West Africa, West Indies, and Brazil, *Tryon.*

The spire of this species is rather exserted, making the general form more elongate as compared with other members of this genus. The lip is simple with a slight thickening of white nacreous deposit, which gradually diminishes towards the interior. The lunate spots which characterize this species are not well marked in young specimens, the painting being diffused rectangular and linear spots.

[2] Morch, Malak. Blatt. 18 (1871) 16; Hedley, Rec. Aust. Mus. 12 (1919) 329; Faustino, Bur. Sci. Monog. 25 (1928) 225.

[3] Sowerby, Conchol. Man. (1852) 146.

[4] Tryon, Struct. Syst. Conchol. 2 (1883) 202.

[5] Tryon, Man. Conchol. 7 (1885) 261.

DOLIUM OLEARIUM (Bruguiére) non Linnæus. Plate 1, fig. 2.

Dolium olearium Bruguiére, LAMARCK, Anim. sans Vert. 7 (1822) 259; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, fig. 14; TRYON, Man. Conchol. 7 (1885) 262, pl. 2, figs. 8–11; HIDALGO, Cat. Marine Moll. (1904) 153.

Dolium olearium Lamarck var. KIENER, Icon. Coq. Viv. *Dolium* p. 6, pl. 1, fig. 1*a*.

Tonna olearia Bruguiére, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell globosely ovate, ventricose, umbilicated; spire but a little exserted; sutures channeled; whorls six to seven, transversely ribbed, ribs broad, close-set, flatly depressed, grooves between ribs narrow and shallow; fulvous-chestnut, maculated with white; interior of aperture dark fulvous brown, whitish towards the lip; lip simple; columella arched, splashed with white nacreous material.

Height, 85 mm; thickness, 66; height of spire, 20; height of body whorl, 71.

Philippines, *Bur. Sci. 1355, 2676 Quadras.* MINDORO, Puerto Galera, *Bur. Sci. 14673 Seale.* MARINDUQUE, *Elera.* CEBU, *Bur. Sci. 14218 Quadras.* BOHOL, *Bur. Sci. 14167 Kelly.* MINDANAO, *Bur. Sci. 1371 Quadras;* Surigao, *Elera.* LEYTE, NEGROS, and JOLO, *Hidalgo.*

Distribution.—Indian Ocean, *Lamarck.*

This species is characterized by white longitudinal markings each paired with chestnut similar to those of *D. deshayesii,* but rather of a different pattern and mode of distribution. The suture is very deeply channeled.

DOLIUM CUMINGII Hanley. Plate 1, fig. 4.

Dolium cumingii HANLEY, Proc. Zool. Soc. (1859) 491; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, figs. 13*b, c;* HIDALGO, Cat. Marine Moll. (1904) 152.

Dolium olearium var. *cumingii* Hanley, TRYON, Man. Conchol. 7 (1885) 262, pl. 2, fig. 9.

Tonna cumingii Hanley, HEDLEY, Rec. Aust. Mus. 12 (1919) 331; FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell globosely ovate, ventricose, umbilicated; spire rather short; sutures deep; whorls six to seven, transversely ribbed, ribs nineteen, rather flattened, a little rounded, close-set; grooves distinct; fulvous-chestnut with spiral longitudinally lineated brown and white bands; interior fulvous-brown; columella slightly twisted; lip simple with a slight thickening of white porcelaneous deposit within, somewhat denticulated.

Height, 58 mm; thickness, 48; height of spire, 17; height of body whorl, 50.

Philippines, *Cuming.* POLILLO, *Bur. Sci. 12944 Robinson.*

Distribution.—Australia, *Hedley.*

Tryon, in his Manual of Conchology, placed this species with *D. deshayesii* as varieties of *D. olearium.* However, there seems to be enough difference to warrant the separation of this as an independent species. *Dolium cumingii* is smaller, a bit more globose, the sutures not channeled, and the type or pattern of markings is not similar to that of *D. olearium.*

DOLIUM DESHAYESII Reeve. Plate 1, fig. 5.

Dolium deshayesii REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, fig. 13*a*; HANLEY, Proc. Zool. Soc. (1859) 490; HIDALGO, Cat. Marine Moll. (1904) 152.

Dolium olearium var. *deshayesii* Reeve, TRYON, Man. Conchol. 7 (1885) 262, pl. 2, fig. 10.

Tonna olearia Reeve, FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell thin, ovate, rather globose, ventricose, umbilicated; spire short; sutures distinct; whorls six, transversely ribbed, ribs twenty-three, somewhat flattened, a little rounded, close-set; grooves distinct; whitish or pale fulvous-brown, painted with bands of white and brown spots; interior of aperture whitish or very light brown; columella slightly twisted; lip simple with a slight thickening of white porcelaneous deposit within, somewhat denticulated.

Height, 59 mm; thickness, 40; height of spire, 19; height of body whorl, 42.

Philippines, *Bur. Sci. 13207 Fulton.*

This species seems to be limited to the waters of the Philippine Islands, where the type specimen was collected by Cuming.

The affinity of this species is more with *D. cumingii* than with *D. olearium;* the general form and character of the ribs are the same, differing only in the distribution and design of the spots, and in the extent of the excavation of the sutures.

DOLIUM ZONATUM Green. Plate 1, fig. 3.

Dolium zonatum GREEN, Trans. Albany Inst. 1: 131; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 7, figs. 12*a*, *b*; TRYON, Man. Conchol. 7 (1885) 263, pl. 3, fig. 17; HIDALGO, Cat. Marine Moll. (1904) 153.

Shell thin, ovately globose, umbilicated, spire a little exserted; sutures channeled; whorls six, transversely ribbed, ribs sixteen, rather convex; grooves broad, those at the anterior portion each decorated with a small rib, those at the upper part with two or three; dark reddish chestnut, spire somewhat lighter, apex

black; interior dark chestnut glazed with a uniform grayish color; columella twisted; lip simple.

Height, 168 mm; thickness, 129; height of spire, 42; height of body whorl, 147.

LUZON, Manila Bay, *Bur. Sci. 14674 Lopez.* Obtained with beam-trawl nets at a depth of 20 to 23 fathoms.

Distribution.—China, *Cuming;* Japan, *Tryon;* Philippines (?) *Elera.*

Reeve noted that "this is the only species of the genus in which there is an isolated raised line between the interstices of the lower ribs of the shell." These are very well marked in the specimens under consideration. In the three spaces at the upper part of the body whorl there are three of these raised lines, a characteristic present only in the young of *D. galea.* This is the largest specimen in the Bureau of Science collection, of a uniform dark reddish chestnut except near the apex. Others are a little more elongated, narrower, and yellowish chestnut.

DOLIUM SULCOSUM (Born). Plate 2, fig. 2.

Buccinum sulcosum Born, DILLWYN, Cat. Recent Shells 2 (1817) 584.
Dolium fasciatum Bruguiére, LAMARCK, Anim. sans Vert. 7 (1822) 260; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 7, figs. 11*a, b;* TRYON, Man. Conchol. 7 (1885) 263, pl. 3, fig. 16; HIDALGO, Cat. Marine Moll. (1904) 153.
Tonna sulcosa Born, HEDLEY, Rec. Aust. Mus. 12 (1919) 335.
Tonna fasciata Bruguiére, FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell globosely ovate, scarcely umbilicated, spire a little exserted; sutures rather channeled; whorls six to seven, transversely ribbed, ribs nineteen, flatly convex, sharp-edged, rather distant; creamy white, encircled with five broad brownish bands, which fade towards the outer lip; apex dark chestnut; interior whitish, outer lip reflected, fimbriately denticulated; columella a little twisted.

Height, 83 mm; thickness, 63; height of spire, 18; height of body whorl, 67.

LUZON, *Elera:* Manila Bay, *Lopez collection.* MINDORO, *Lopez collection.* CEBU, *Hidalgo.*

Distribution.—Indian Ocean, *Lamarck;* Chinese Seas, *Humphreys;* China and Japan, *Tryon;* coasts of Coromandel, *Martini;* Australia, *Hedley.*

This species very closely resembles *D. allium* and may be very easily confused with it except for the five broad chestnut bands, and the finer and closer-set ribs of this species.

DOLIUM ALLIUM (Dillwyn). Plate 2, fig. 4.

Buccinum dolium var. *B. Buccinum allium* from Solander's MSS, DILLWYN, Cat. Recent Shells 2 (1817) 585.

Dolium costatum Deshayes, REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 5, fig. 8.

Dolium fasciatum var. KIENER, Icon. Coq. Viv. *Dolium* p. 11, pl. 4, fig. 6.

Dolium latesulcatum Martini, HANLEY, Proc. Zool. Soc. (1859) 489.

Dolium costatum Menke, TRYON, Man. Conchol. 7 (1885) 263, pl. 4, fig. 19; HIDALGO, Cat. Marine Moll. (1904) 152.

Tonna costata Menke, SHIRLEY, Proc. Roy. Soc. Queensland 22 (1911) 98; HEDLEY, Rec. Aust. Mus. 12 (1919) 334; FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Tonna allium Dillwyn, IREDALE, Rec. Aust. Mus. 18 (1931) 215.

Shell oblong-ovate, ventricose, slightly umbilicated; spire rather exserted, sutures very slightly channeled; whorls seven, transversely ribbed, ribs thirteen, prominent, somewhat rounded; interstices broad, concave, smooth; creamy white; ribs slightly brownish, apex black; interior white, lip fimbriated, inner border denticulated; columella twisted.

Height, 100 mm; thickness, 71; height of spire, 35; height of body whorl, 82.

Philippines, *Bur. Sci. 13217 Fulton, Bur. Sci. 2687 Quadras.* CEBU, *Bur. Sci. 1343, 11907 Quadras.* BANTAYAN, *Bur. Sci. 13744 Lopez.* MARINDUQUE, *Hidalgo.* MINDANAO, Zamboanga, *Hidalgo.* BASILAN, *Hidalgo.*

Distribution.—Australia, *Hedley.* Dillwyn listed Sicily and Barbary, *Bonnani;* Amboina, *Rumphius;* Philippine Islands, *Petiver;* Senegal, *Adanson;* Tranquebar, *Martini;* very common about Tarentum, *Ulysses.* The writer could not ascertain which of these localities refer to *B. dolium* and which to *B. allium.*

This species with its prominent distant ribs may be distinguished from *D. fimbriatum* by the absence of the brown spots on the ribs, and from *D. sulcosum* by the absence of the five broad brownish bands.

DOLIUM FIMBRIATUM Sowerby. Plate 2, fig. 1.

Dolium fimbriatum SOWERBY, Genera Rec. Foss. Shells 2 (1827) pl. 242, fig. 2; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 3, fig. 3*b* (not 3*a*); HANLEY, Proc. Zool. Soc. (1859) 491; HIDALGO, Cat. Marine Moll. (1904) 153.

Dolium lischkeanum Küster, DUNKER, Index Molluscorum Maris Japonici (1882) 57.

Dolium costatum var. *fimbriatum* Sowerby, TRYON, Man. Conchol. 7 (1885) 264, pl. 4, fig. 22; pl. 3, fig. 18.

Tonna fimbriata Sowerby, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell globosely ovate, ventricose, slightly umbilicated; spire but a little exserted; sutures distinct; whorls six, transversely ribbed, ribs fourteen, prominent, somewhat rounded; interstices broad, concave, smooth; creamy white, ribs spotted with fawn-brown; apex dark chestnut, interior of aperture brown; lip fimbriated, a little exserted, denticulated within, columella a little twisted, callous anteriorly.

Height, 92 mm; thickness, 69; height of spire, 22; height of body whorl, 78.

LUZON, Manila Bay, *Lopez collection.* MINDORO, Naujan, *Bur. Sci. 1350 Quadras.* BOHOL, *Elera.* PALAWAN, Banga, *Bur. Sci. 14217 Quadras.* CEBU and NEGROS, *Hidalgo.* MINDANAO, Dapitan, *Bur. Sci. 1351 Quadras.* Davao and Zamboanga, *Hidalgo.*

Distribution.—Senegal and Japan, *Tryon.*

This species and *D. maculatum* have been placed by Tryon as varieties of *D. allium.* The shell of the first is more globose, the spire shorter, and the ribs spotted with brown. Reeve, however, noted the difference in the number and character of the ribs among these three closely related species.

Subgenus MALEA Valenciennes

Shell solid, lip thickened, somewhat reflected, denticulated within.

DOLIUM (MALEA) POMUM (Linnæus). Plate 2, fig. 3.

Buccinum pomum LINNÆUS, Syst. Nat. ed. 12 1^2 (1767) 1197; DILLWYN, Cat. Recent Shells 2 (1817) 583.

Dolium pomum Linnæus, LAMARCK, Anim. sans Vert. 7 (1822) 261; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 4, figs. 6*a, b;* TRYON, Man. Conchol. 7 (1885) 265, pl. 5, fig. 26; KIENER, Icon. Coq. Viv. *Dolium* p. 12, pl. 5, fig. 8.

Malea pomum Linnæus, HIDALGO, Cat. Marine Moll. (1904) 153.

Tonna (*Malea*) *poma* Linnæus, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell elongately ovate, solid, very slightly umbilicated; spire short; sutures deep; whorls six, transversely ribbed, ribs thirteen to fourteen, prominent, rounded, those at the middle rather flattened; whitish to light fulvous-bay, sprinkled with white and yellowish spots; interior dark orange, aperture somewhat contracted; lip thickened, flatly reflected, denticulated within; columella rudely ribbed, callous, excavated towards the base.

Height, 62 mm; thickness, 45; height of spire, 10; height of body whorl, 58.

Philippines, *Bur. Sci. 13208 Fulton.* LUZON, Bataan Province, Moron, *Hidalgo.* MINDORO, Naujan, *Hidalgo.* MARINDU-

QUE and CEBU, *Hidalgo.* MINDANAO, Zamboanga, *Bur. Sci. 1348, Quadras.*

Distribution.—Java, *Linnæus;* coasts of Spanish America, *Bonanni;* Amboina, *Rumphius;* China, *Humphreys;* Red Sea and Indian Ocean, *Tryon;* Indian Ocean, *Kiener;* Society Islands, *Cuming.*

This species is of the *Cassis* form, being solid with the lip thickened, toothed and reflected, and the columella covered with a callosity of white enamel. The excavation at the base of the columella as noted by Reeve is but slight.

Genus PYRULA Lamarck (restricted)

(*Ficula* Swainson)

Shell thin, pyriform, ventricose; spire short; body whorl broad, canaliculated at the base, canal prolonged; aperture elongated, columella thin; lip simple.

Of the nine species of *Pyrula*[6] listed by Faustino six belong to other genera; *colossea* Lam., *lactea* Reeve, and *ternatana* Lam. belong to *Hemifusus; galeodes* Lam. belongs to *Melongena; mawæ* Gray to *Rapana;* and *rapa* Linn. to *Rapa.* Of the three remaining, *ficus* Linn. and *lævigata* Reeve are synonimous, leaving only two species. To these two *dussumieri*[7] was added, giving a total of three valid Philippine species. In Hidalgo's work[8] two species, *ficus* Linn. and *reticulata* Lam., and one variety, *ficoides* Lam., are listed.

PYRULA RETICULATA Lamarck. Plate 2, fig. 5.

Pyrula reticulata LAMARCK, Anim. sans Vert. 7 (1822) 141; KIENER, Icon. Coq. Viv. *Pyrula* p. 28, pl. 12, fig. 1; TRYON, Man. Conchol. 7 (1885) 265, pl. 5, fig. 28; pl. 6, fig. 33; HIDALGO, Cat. Marine Moll. (1904) 154; FAUSTINO, Bur. Sci. Monog. 25 (1928) 227.

Pyrula ficoides LAMARCK, Anim. sans Vert. 7 (1822) 142.

Ficula reticulata LAMARCK, Reeve, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 1.

Pyrula clathrata ROUSSEAU, Proc. Zool. Soc. (1852) 185.

Shell thin, pyriform, ventricose; spire flatly depressed; sutures shallow; reticulately cancellated with sharp longitudinal and spiral ridges, the latter generally alternating large and small; pale yellowish brown encircled with five obscure whitish transverse bands, maculated with reddish brown; interior pale violet; lip simple, columella thin.

[6] Faustino, Bur. Sci. Monog. 25 (1928) 226.
[7] Alcasid, Philip. Journ. Sci. 60 (1936) 423.
[8] Hidalgo, Cat. Marine Moll. (1904) 154.

Height, 70 mm; thickness, 38; height of spire, 5; height of body whorl, 65.

LUZON, Manila Bay, *Lopez collection:* Batangas Province, Taal, *Bur. Sci. 2689 Quadras.* SULU, *Adams;* Jolo, *Elera.*

Distribution.—Indian Ocean, *Lamarck;* East Indies and Japan, *Tryon.*

This species has been erroneously figured by Sowerby [9] as *P. decussata* Wood, while the figure for the true *P. decussata* was described as *P. reticulata.* The specimens figured here show very clearly the reticulately decussated surface of the entire shell; the transverse ridges being alternate coarse and fine striæ; marked with five faint whitish narrow bands and spotted with reddish brown throughout. It approaches *P. ficus* in shape but differs from it by the decussated surface.

PYRULA DUSSUMIERI Valenciennes. Plate 2, fig. 6.

Pyrula dussumieri Valenciennes, KIENER, Icon. Coq. Viv. *Pyrula* p. 25, pl. 11; TRYON, Man. Conchol. 7 (1885) 266, pl. 5, fig. 30; ALCASID, Philip. Journ. Sci. 60 (1936) 423.

Ficula dussumieri Valenciennes, REEVE, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 2; SOWERBY, Thes. Conchyl. 4 (1880) 110 *Ficula* pl. 423, fig. 5.

Shell thin, elongately pyriform, slender, spire short, sutures shallow; transversely ridged, ridges coarse, smooth, rather depressed; grooves distinct, cancellated with fine longitudinal striæ; pale fawn, painted with longitudinal wavy light brown streaks; interior fawn-brown, whitish towards the lip, lip simple.

Height, 97 mm; thickness, 45; height of spire, 8; height of body whorl, 91.

LUZON, Manila Bay, *Bur. Sci. 14660 Lopez.* Collected with beam-trawl nets at a depth of 15 to 20 fathoms.

Distribution.—China, *Cuming.*

A very fine species characterized by its slender form and by the wavy longitudinal light brown streaks. The sculpture of the surface is similar to *P. reticulata* but differs from it by its more elongated form. Hidalgo [10] listed this species as one cited from the Philippines, but decided in the meantime to place it as a Chinese species.

PYRULA FICUS (Linnæus). Plate 2, fig. 7.

Bulla ficus LINNÆUS, Syst. Nat. ed. 12 1^2 (1767) 1184; DILLWYN, Cat. Recent Shells 1 (1817) 484.

[9] Sowerby, Thes. Conchyl. 4 (1880) 110, pl. 423, figs. 1, 2, 3.
[10] Hidalgo, Cat. Marine Moll. (1904) 154.

Pyrula ficus LAMARCK, Anim. sans Vert. (1801) 82; KIENER, Icon. Coq. Viv. *Pyrula* p. 30, pl. 13, fig. 1.
Ficula lævigata REEVE, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 4.
Ficula ficus Linnæus, SOWERBY, Thes. Conchyl. 4 (1880) 109 *Ficula* pl. 423, fig. 4.
Pyrula ficus Linnæus, TRYON, Man. Conchol. 7 (1885) 266, pl. 5, fig. 29; pl. 6, fig. 36 (not 37); HIDALGO, Cat. Marine Moll. (1904) 154; FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell thin, abbreviately pyriform, ventricose; spire short; sutures shallow; transversely lightly ridged, ridges flat, smooth, spotted with reddish brown, cancellated with fine, scarcely visible, longitudinal striæ; pale fawn encircled with five transverse obscure whitist bands, maculated throughout with broad patches of dark chestnut; interior pale violet; lip simple.

Height, 70 mm; thickness, 44; height of spire, 7; height of body whorl, 65.

Philippines, *Bur. Sci. 13219 Fulton.*

Distribution.—Amboina, *Linnæus;* Red Sea, Indian Ocean, and Singapore, *Tryon;* Moluccas, *Lamarck;* Eastern Seas, *Cuming.*

This species is shorter and more ventricose than the other members of the genus; the surface is so slightly sculptured as to render it rather smooth. The original Linnæan *Bulla ficus* contained two distinct species. Lamarck separated one of them and named it *Pyrula reticulata,* retaining *ficus* for the other. Reeve later "to avoid tautology" changed the name *ficus* to *laevigata.*

ILLUSTRATIONS

Plate 1

Fig. 1. *Dolium perdix* (Linnæus).
2. *Dolium olearium* (Bruguiére).
3. *Dolium zonatum* Green.
4. *Dolium cumingii* Hanley.
5. *Dolium deshayesii* Reeve.

Plate 2

Fig. 1. *Dolium fimbriatum* Sowerby.
2. *Dolium sulcosum* Born.
3. *Dolium* (*Malea*) *poma* (Linnæus).
4. *Dolium allium* (Dillwyn).
5. *Pyrula reticulata* Lamarck.
6. *Pyrula dussumieri* Valenciennes.
7. *Pyrula ficus* (Linnæus).

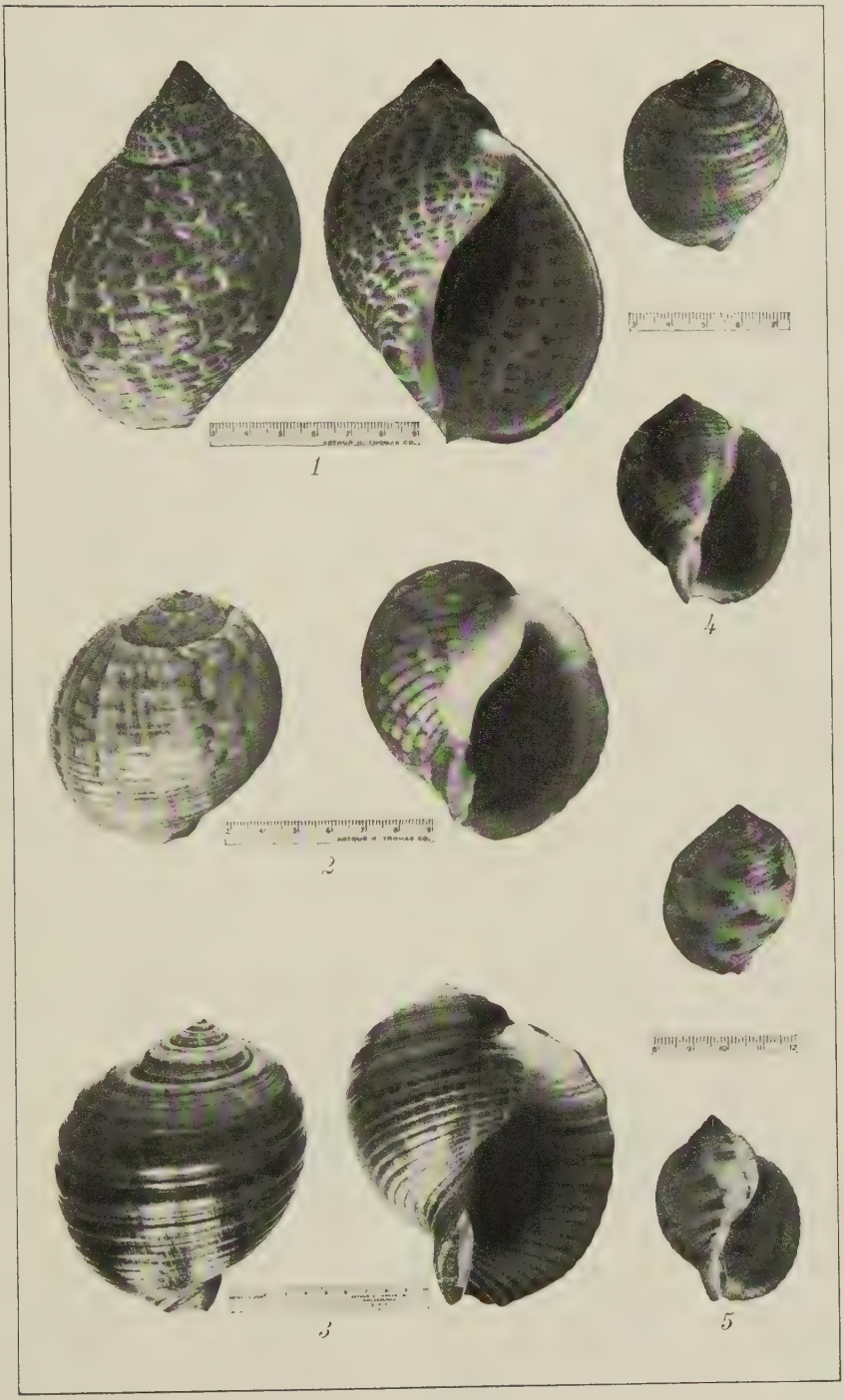

PLATE 1.

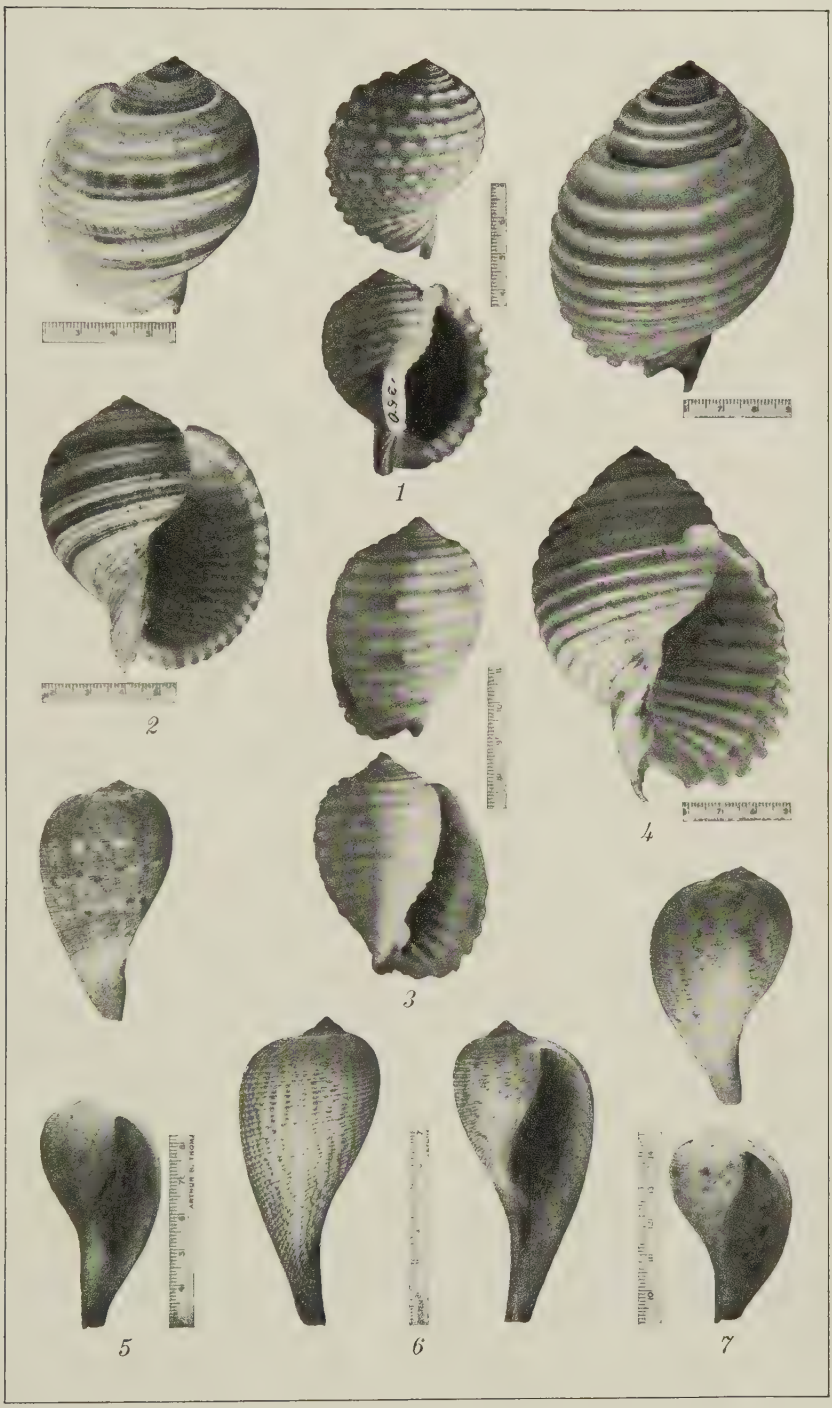

PLATE 2.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

American society for testing materials. Symposium on spectrographic analysis. Philadelphia, The Society, 1935. 51 pp., tables, diagrs. Price, $0.65.

American society for testing materials. Cleveland district committee. Symposium on peralitic malleable cast iron. Philadelphia, The Society, 1936. 22 pp., illus., diagr. Price, $0.60.

BLANCK, A. P. Foods and the law; a manual for the business man and the laws of the United States with reference to foods and food products. N. Y., Peter Smith, 1935. ix + 246 pp. Price, $2.50.

COLLINGS, G. H. Commercial fertilizers; their sources and use. Philadelphia, P. Blakiston's son & co. [c. 1934.] xiv + 325 pp. illus. tables. Price, $3.25.

COOPER, L. F., E. M. BARBER, and H. S. MITCHELL. Nutrition in health and disease for nurses. 6th ed., rev. and reset, Philadelphia, J. B. Lippincott co. [c. 1933.] xiv + 711 pp., illus., tables, fold., diagr., col. plate. Price, $3.

DOWELL, A. A., and O. B. JESNESS. The American farmer and the export market. Minneapolis, University of Minnesota press. [c. 1934.] v + 269 pp., maps, tables, diagrs. Price, $2.

FARRINGTON, BENJAMIN. Science in antiquity. (Home university library of modern knowledge.) London, Thornton Butterworth, 1936. 255 pp. Price, $0.75.

GIFFORD, J. C. The tropical subsistence homestead; diversified tree crops in forest formation for the Antillean area. N. Y., Books inc. [c. 1934.] 158 pp. Price, $0.50.

GLASSTONE, SAMUEL, and A. HICKLING. Electrolytic oxidation and reduction: inorganic and organic. New York, D. Van Nostrand co., inc., 1936. ix + 420 pp., tables, diagrs. Price, $9.

HAIRE, NORMAN. Birth-control methods (contraception, abortion, sterilization). London, George Allen & Unwin, 1936. 192 pp., illus., plates. Price, $1.75.

HATHAWAY, K. A. Modern radio essentials. Chicago, American technical society, 1936. 200 pp., illus., tables, diagrs. Price, $2.

HAVEN, G. B. Industrial fabrics; a handbook for engineers, purchasing agents, and salesmen. 1st ed. New York, Wellington Sears co., 1934. x + 538 pp., illus., fold. plates, tables, diagrs. Price, $2.

HAVENS, L. C. The bacteriology of typhoid, salmonella, and dysentery infections and carrier states. N. Y., The Commonwealth fund, 1935. xii + 158 pp., illus., diagrs. Price, $1.75.

Imperial agricultural bureaux. Vernalization and phasic development of plants. Aberystwyth and Cambridge, Imperial bureaux of plant genetics, 1935. 151 pp., tables. Price, $2.50.

Imperial college of tropical agriculture. Cacao research. 4th annual report, 1934. Trinidad, Govt. print. off., 1935. Price, $2.50.

KARPMAN, BEN. The individual criminal; studies in the psychogenetics of crime. Washington, D. C., Nervous and mental diseases pub. co. [c. 1935.] x + 317 pp. Price, $4.50.

KIRK, G. L. Philippine independence, motives, problems and prospects. N. Y., Farrar & Rinehart, 1936. 278 pp. Price, $2.50.

KOFOID, C. A., and others, ed. Termites and termite control. Berkeley, University of California press, 1934. xxvii +795 pp., front., illus., tables, diagrs. Price, $5.

LEFENETRE, H., and P. DEDIEU. Technique systématique de l'inspection des viandes de boucherie. Paris, Vigot Frères, 1936. viii + 408 + xxix pp., illus.

LULL, R. S. Fossils; what they tell us of plants and animals of the past. N. Y., The University society. [c. 1931.] iv + 114 pp., illus. Price, $0.65.

MAINGOT, GEORGES, RAYMOND SARASIN, and HENRI DUCLOS. Exploration radiologique des colons et de l'appendice au moyen des solutions floculantes images de muqueuses; technique-séméiologie-syndromes. Paris, Masson et cie, 1935. 229 pp., illus. Price, 200 fr.

NOBLE, R. J. Latex in industry. N. Y., The Rubber age, 1936. 384 pp., illus. Price, $7.

OCHSNER, E. H. Social security. Wisconsin, New era library, inc., 1935. xx + 231 pp. Price, $0.50.

PATTEE, A. F. Practical dietetics, with reference to diet in health and disease. 12th ed. rewritten and reset. Mount Vernon, N. Y., 1935. xv + 880 pp., illus., tables. Price, $3.

SEYMOUR, E. L. D., ed. The garden encyclopedia; a complete practical and convenient guide to every detail of gardening. New York, Wm. H. Wise & co., 1936. x + 1300 pp., illus., plates. Price, $5.

SNYDER, T. E. Our enemy the termite. Ithaca, N. Y., Comstock pub. co., 1935. xii + 196 pp., illus. Price, $3.

Success Publishing co. Success; 1500 new economy cookery and household recipes. London, The Author. [n. d.] 256 pp., col. illus. Price, $1.25.

THURSTAN, VIOLETTA. The use of vegetable dyes for beginners. rev. ed., Leicester, The Dryad press, 1936. 51 pp. Price, $0.70.

VAN UVEN, M. J. Mathematical treatment of the results of agricultural and other experiments. Groningen, Batavia, P. Hoordhoff, 1935. vi + 309 pp. Price, $3.75 unbound; $4 bound.

WHITBY, L. E. H. Disorders of the blood; diagnosis, pathology, treatment and technique. Philadelphia, P. Blakiston's son & co., 1935. viii + 543 pp., illus., col. plates, diagrs., tables. Price, $7.

WIESNER, B. P. Sex. London, Thornton Butterworth, 1936. 251 pp., illus. Price, $0.75.

WILLIAMS, F. H. Radium treatment of skin diseases; new growths, diseases of the eyes and tonsils. Boston, The Stratford co. [c. 1935.] iii + 118 pp. plates. Price, $2.

WILSON, G. S. The bacteriological grading of milk. London, H. M. Stationery off., 1935. 392 pp., tables, diagrs. Price, $2.

WOLF, F. A. Tobacco diseases and decays. Durham, North Carolina, Duke university press, 1935. xix +454 pp., illus. Price, $5.

WOLLENWEBER, H. W., and O. A. REINKING. Die fusarien; ihre beschreibung, schadwirkung und bekämpfung. Berlin, Paul Parey, 1935. viii + 355 pp., illus. Price, in Germany, Rm. 18, unbound; Rm. 20, bound; foreign, Rm. 13.50, unbound; Rm. 15, bound.

ZIMMER, FRITZ. Nitrocellulose ester lacquers; their composition, application and uses. N. Y., D. Van Nostrand co., 1934. xv + 246 pp., illus., plates, tables. Price, $7.

REVIEWS

The Chemical Control of Conception. By John R. Baker. With a chapter by H. M. Carleton. Chapman and Hall, Ltd., London, 1935. 173 pp. Price, $3.75.

This book gives a resumé of the results of the author's series of experimental investigations on the action of some chemical substances as spermicides. The author describes the technic, which he has standardized for grading contraceptive agents, and gives the results of the same scientific tests when applied to other substances that may be used for this purpose.

Judging from the net result of his experiments, however, it would seem that the perfect spermicide has yet to be discovered, inasmuch as the really potent contraceptive agent that is devoid of pathological effect has not yet been found.

The author has found that certain substances that reduce surface tension, such as soap, have high spermicidal effect. Thus Castile soap (sodium oleate) has been found as spermicidal as quinine bisulphate, which is twenty-seven times as expensive.

This book enables one to become acquainted with contraceptive materials better than those now available, but less known or only imperfectly understood. This book will be found a valuable addition to existing literature on conception by the physician, the chemist, the pharmacologist, the physiologist, and the biologist.—A. P. W.

A Text Book on Forest Management. By M. R. K. Jerram. Chapman and Hall, Ltd., London, 1935. 156 pp., 17 figs. Price, $2.25.

Written to meet the requirements of forest students, this book brings together, in as brief and simple a manner as possible, all matters of primary importance relating to the subjects which are commonly dealt with under the term "forest management." The author claims that "it is not intended to displace the study

of those authors who deal with these subjects individually at much greater length; but it does represent an endeavor to introduce the students to all the more important problems involved and to explain the elementary principles on which their solutions are based." At most, therefore, the book provides a framework on which fuller knowledge of forest management can be built up by the teacher.

The book is divided into three parts. Part I deals with the foundations of forest management; part II, with the preparation and control of a working plan; part III, with forest finance. In appendix I are found the terms used in forest management as approved by the Empire Forestry Conference in 1928. The values of I, op^n are also found in appendix II.—C. S.

American Conservation in Picture and Story. Compiled and edited by Ovid Butler. The American Forestry Association, Washington, D. C., 1935. 144 pp., 216 illus. Price, $2.50.

This book, which was issued by the American Forestry Association to commemorate the completion of its sixty years of public service in behalf of American forestry, gives a comprehensive and graphic picture of the history of conservation in the United States. The movement to awaken public sentiment in conservation work dates from 1875, the year in which the association was organized, and this volume records the accomplishments largely to be credited to its efforts.

The book was prepared with the coöperation of authorities on the various phases of conservation in the United States and includes such topics as the beginning of forest exploitation, the public domain, the age of wood, the story of lumbering, the National forests, the National parks, the conservation of wild life, the spread of forest education, forest research, and conservation of the soil. The more recent activities under the New Deal, such as the Civilian Conservation Corps and the Lumber Code, are also discussed. A selected reading list of references is given at the end.—C. S.

Wanderings Among South Sea Savages and in Borneo and the Philippines. By H. Wilfrid Walker. H. F. and G. Witherby, Ltd., London, 1935. 254 pp., illus. Price, 7s, 6d.

The favorable reception accorded this book since its original publication in 1909 seems to be the excuse for this second reissue.

The book is a remarkable record of adventure and gives interesting accounts of the author's wanderings among primitive

inhabitants of the South Sea Islands before the World War. Its interest lies in the fact that in giving a general impression of his experiences the author affords an insight into the life of the people visited. As realized by himself, however, in his attempt to be as concise as possible, the author has left out much that might have been interesting. Having no pretension to be "scientific" in his accounts, as he claims, he has therefore touched but lightly on the general customs of the people and has made no special study of their languages. Even such superficial treatment of these two cultural phases of primitive life, however, makes the book a valuable reading material for students of ethnology, besides being an interesting book of travel to others.—R. E. G.

Head, Heart and Hands in Human Evolution. By R. R. Marett. Henry Holt and Co., New York, 1935. 303 pp. Price, $3.50.

A book that affords interesting reading on sociological inquiry is this study by Doctor Marett, rector of Exeter College, Oxford, and one of the leading students of social anthropology and primitive religion. Marett discusses the three fundamental ways of organizing human experience; namely, by means of the head, the heart, and the hands. In part I he brings attention to the question of how to use and to keep one's head in tackling the theoretical problems involved in sociological inquiry; in parts II and III he deals with pretheologic religion, giving illustrations; and in part IV he considers primitive technology or the arts and crafts of prehistoric and primitive man.—R. E. G.

The Duke Forest, a Demonstration and Research Laboratory. By Clarence F. Korstian and William Maughan. Duke University, Forestry Bulletin No. 1. Durham, N. C., 1935. 74 pp., illus., maps.

This publication describes the Duke Forest of Duke University in Durham, North Carolina, the administration and policies controlling its operation, and the progress already achieved. The forest is somewhat similar to the Makiling National Park at Los Baños, Laguna, in that it serves the threefold purpose of demonstration, research, and outdoor laboratory in forestry. The area contains 4,696.1 acres (1,878.4 hectares) 3,411.3 acres of which are covered with forests of various types, stands, and soils. The forest is divided into three divisions containing 114 compartments, with natural or artificial boundaries, ranging in size from 5.6 to 84.5 acres with an average of 40.1 acres.

The management policy aims to make the forest serve as an area for the development and demonstration of forestry prac-

tices, as an experiment forest for research in the problems of timber growing and in the sciences basic thereto, and as an outdoor laboratory where field work can be carried on by forestry students. There are 48 permanent sample plots, ranging in size from 0.1 to 1 acre, for the purpose of studying various problems and to serve as centers of demonstration activities. In managing the forest the aim is to limit the cut within the annual growth, giving due consideration, however, to needed sanitation and silvicultural operations such as pruning, thinning, planting, and removal of defective trees. A very interesting part of the publication is the chapter dealing with the various forms used and the system of keeping forest records. Although the forest is primarily established for demonstration and research, it is also managed as a business, and complete financial record is maintained.

A description of the progress already accomplished in regard to land classification, forest protection, regulation of the cut, and silvicultural operations is given.

This is a handy, well-written bulletin, profusely illustrated with photographs and maps, giving a good idea of the Duke Forest, its present condition, and its possibilities.—C. S.

Kleines Handbuch des Hoch-, Ingenieur- und Machinenbaus. Von Dr. Phil. H. H. Schwanecke. Newmann-Neudamm, Berlin, 1934. Vol. I, cloth, 855 pp., illus., diagram, charts, tables. Price, 25 RM.

The author has successfully achieved the promise implied in the title by this very concise but complete presentation of two major branches of engineering. The book is richly illustrated with figures, diagrams, and charts.

Each subject—mathematics, chemistry and physics, technical mechanics, thermodynamics, and design—is remarkable in its brevity, scope, and clearness. The subject of mathematics is especially notable for the clearness of presentation in no more than one hundred sixty-three pages. It includes forty-one pages of mathematical tables, ten pages of fundamental formulas of algebra and trigonometry, besides a thorough discussion on analytic geometry and differential and integral calculus. Chemistry and physics are very lightly treated, giving only principal information for general use to the engineer. Technical mechanics covers the various technical notations, equivalents, and measuring units, dynamics and statics of rigid bodies, as well as of fluids. Under the general heading of thermodynamics is included a brief discussion of wind pressure. The design of structures is adequately covered.

It is not only a valuable book for the practicing engineer in his everyday work but is also an excellent text when he wishes to review subjects which have become dim in his memory. It is true that there are many excellent American and English texts dealing with the subjects covered by this book, but it always aids greatly in the perspective of an engineer to be also familiar with the German methods and points of view on the subjects covered by this handbook. In many of the engineering fields Germany has pioneered and has remained a foremost authority.—A. A.

Why the Weather? By Charles F. Brooks. With the collaboration of Eleanor Stabler Brooks and John Nelson. Revised and enlarged. Harcourt Brace and Co., New York, 1935. 295 pp., illus. $2.50.

This book is a veritable mine of information for those who are curious about the why and wherefore of the weather. It is purposely written for the popular mind and is attractively presented; it presents just those things which the general public would like to know. It has the further advantage of being thoroughly up-to-date, the revision having been carefully and conscientiously made. Even though it is an American book evidently compiled for an American public, and treats of many things beyond the experience of the average Filipino, such as sleet, snow, ice-storms, autumn and winter storms in general, still even residents of these Tropical Isles can find these topics interesting, entertaining, and instructive.

One might be inclined to judge hastily that the book deals too much with climatological explanations and not enough with weather forecasting, but this is really an error, for if the manifold hints about forecasting scattered here and there throughout the book were collected they would form quite a comprehensive chapter or two. However, Philippine readers should be careful to remember that the forecasting rules are for the United States or for the temperate zones in general and not for the Philippines. We are in an almost entirely different clime, as weather men trained in the former zones sometimes find to their sorrow.

As far as can be judged from a first perusal, facts are accurately stated, with possibly a few minor exceptions. The writer hardly thinks that a definite correlation has been proved between earthquakes and intense cyclones, nor does he think that such a theory meets with the approval of a majority of seismologists. On page 154, at the top, the statement is made that a typhoon commenced at Yokohama, just before the great earthquake and affected Tokyo soon after. As a matter of fact

the storms was already definitely a typhoon August 28 (the earthquake occurred September 1, 1923) in the Eastern Sea, and most probably started some days earlier south of the Loochoo (Nansei) Islands as a secondary to an occluded typhoon which passed near to the east of Shanghai, August 24. It was a typhoon of moderate intensity, and many more intense ones have passed over Japan with no earthquakes resulting. In the light of recent investigations of the Manila Observatory, it is also almost certain that the author's explanation of the origin of typhoons and hurricanes will have to be modified; surges of air on the front between different wind systems seem the essential factors rather than doldrum conditions which of themselves seem capable only of causing local overturning of the air.—C. E. D.

Scientific Results of the World Cruise of the Yacht "Alva," 1931, William K. Vanderbilt, Commanding. Crustacea: Anomura, Macrura, Euphausiacea, Isopoda, Amphipoda, and Echinodermata: Asteroidea and Echinoidea. By Lee Boone. Bulletin of the Vanderbilt Marine Museum, Volume VI. Huntington, L. I., New York, privately printed, November 30, 1935. 263 pp., 96 pls.

This bulletin, the sixth in the scientific series of the Vanderbilt Marine Museum, deals with the systematics of the collection secured by William K. Vanderbilt during a world cruise of his yacht "Alva" in 1931. It is divided into two parts, the first being a report on the Crustacea, the second treating of the Echinodermata. As the group of animals described include many forms that are Philippine, this book will be useful to students of Crustacea and Echinodermata in the identification of Philippine material. This is specially so because of the numerous splendid drawings and pictures of the animals described. By using this text in combination with the work of Roxas and Estampador on the Stomatopoda of the Philippines, with Yapchiongco's on pagurids, and with Roxas's on Echinoidea, one will obtain a comprehensive idea of the extent and classification of the Philippine crustaceans and echinoderms.—H. A. R.

International Bibliography on the Problems of Blood Transfusion and the Theory of Blood Groups, 1900–1933. By Dr. E. Koenig. The Scientific Research Institute for Blood Transfusion, Leningrad, 1935. 226 pp.

There are 4,423 articles included in this bibliography, which have been grouped into 22 main sections and 77 subsections. It claims to comprise the articles which were published throughout the world on the problems of blood transfusion and the theory of blood groups during the period 1900–1933. Only the titles in Russian, German, English, French, and Italian are

printed in the original. Titles in other languages, such as Spanish, Dutch, and Portuguese, are translated into German. Those in Russian have also, in addition, their German equivalents. The material is arranged according to an apt scheme. However, the compiler has taken considerable liberty in abbreviating the names of the periodicals, without having provided a handy means for identifying their full titles. It is doubted that the "Periodica Medica," from which the abbreviations have been adopted, will be available to many readers.

The translation of several titles from their original languages into German makes the latter the predominant language of the bibliography. This makes the compilation of distinct advantage to those who are at home in this language, but not to many who read only English or Spanish.—M. G.

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[New names and new combinations are printed in boldface.]

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